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December 27, 1923

Engineering News-Record

Laying 9-foot pipe on Oregon hydro-electric project

In this issue:

Two articles on structural damage resulting from Japanese disaster:

Earthquake Characteristics and Building Resistance, by R. E. J. Summers;
and Earthquake Damage to Japanese Railways, by Mitsuo Nawa

also

Two Trips of Mixer Construct Four-Way Pavement, by John J. Murphy;
Reconstructing Hell Gate Dam to Eliminate Silt

and

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, *Editor*
FRANK C. WIGHT, *Managing Editor*

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Winter Building Facts

WINTER building possibilities assume an increasingly favorable aspect as records of fact are substituted for current opinion. Discussing, recently, steel-skeleton building construction before the New York Building Congress, J. Reid Kilpatrick, Vice-President, Geo. A. Fuller Co., announced that careful statistics covering the firm's operations from 1912 to 1922, a period of ten years, show that the average number of days a year when a winter building program "would be rendered impossible due to temperature conditions" is fourteen. Any increased hazard, because of ice and snow, of winter steel-building construction was not indicated by the firm's records. Nor was it indicated that there was any difference in cost between work begun in winter and that begun in summer. Advocates of a twelve-months-a-year construction industry have always been hampered by lack of quantitative data on winter building conditions. These figures and those published three weeks ago, being developed by the New York Building Congress, serve in a small way to supply the deficiency of facts. It would be a fine thing for the industry if other contractors' organizations would emulate the practice of the New York builders in amassing facts to strengthen the waste prevention arguments becoming somewhat dulled by repetition.

Railroads Using the Highways

AN INNOVATION in freight service put into effect on the Pennsylvania R.R. appears to be a reasonable start toward co-operation between rail and motor transport. On one of its busy lines the local business in less-than-carload lots of freight has been so reduced that the operation of way-freight in this special service is no longer profitable. Consequently the railroad company has abandoned the service and has made arrangements with a trucking organization to call at its stations for the small amount of package freight that is still offered to it for transportation. As a means of doing away with an unprofitable service, this arrangement is admirable. Advocates of store-door delivery may claim that the handlings of the packages should be reduced from four to two by having the trucking concern call for and deliver the packages rather than have the packages delivered to the railroad freight sheds before they are turned over to the truck for movement. Such an arrangement, however, would require the heavy truck used for the long distance moving to do a great deal of traveling in collecting and distributing the individual packages which can be, and now is done by light cars or carts which most concerns maintain for their local business. In addition, the new arrangement probably simplifies the bookkeeping in connection with payment for the shipping, as most concerns of any size have current freight accounts with the railroad company to which the cost of the smaller shipments can be added without the cost of individual collection or of a separate account, which would be necessary under the method of having the trucking company handle the shipment from origin to destination.

To Emphasize Progress in Concrete

IN 1904 the National Association of Cement Users was formed, in recognition of the need for some scientific study of the then infant concrete industry. Next year, in February and at Chicago, the society under its present name, the American Concrete Institute, will celebrate the twentieth anniversary of its founding. Twenty years is not a long time in history of most of the arts, but it comprises practically all of the maturity of the art of designing and making concrete. Because these twenty years have seen concrete rise from the position of foundation material to an almost universal medium of construction expression, the Institute is going to take advantage of the double decennial anniversary to emphasize the progress that has been made. One day of the meeting at Chicago, Feb. 27, is to be devoted to the story of concrete development. The committee which has the meeting in charge has outlined an excellent program with speakers who know the subject and with an exhibit in an adjoining room, both of which should be of exceptional interest. The regular meeting of the Institute will have its usual appeal to those who are concerned with concrete. The inspirational appeal of the one-day session of historic value in concrete should make the February meeting unusually attractive.

Too Big an Undertaking

THE Interstate Commerce Commission, in reversing its decision of last June in which it denied the Virginian Ry. the right to build a short branch line into a new coal field, has taken a step which would imply that it has seen the unwisdom of attempting to control production by determining which coal mines could or could not be opened. The unusual feature of that earlier decision was not that by declining to let the railway build tracks into the new mine the commission did indirectly prevent the opening of the mine, but that the commission specifically stated that in its opinion the mine should not be opened; giving as a further reason for its decision against the building of the spur the fact that the railway had been unable to supply sufficient cars for the mines already in existence along its lines. The far-reaching importance of such a decision is evident, for—lacking the powers of concentrating on coal suggested for it by the report of the Coal Commission—the Interstate Commerce Commission could not well undertake to regulate production in the coal industry unless it also were prepared to regulate production in other industries. It is well that it was able to seize upon the large increase which the

Virginian Ry. has made in its coal-handling facilities as a means of withdrawing from an awkward position in which it had placed itself by an ill considered attempt to improve the coal situation.

Flimsy Prophecies

PROPHECY was ever a precarious occupation, successful only so long as the prophet could preserve a Delphic impartiality or until some one took thought to check up the outcome of past prophecies. The numerous professional economists who have been earning a living for some time forecasting the trend of business have run up against the latter barrier. Someone in the Department of Commerce became curious enough a few weeks ago to compare the course of business with what a dozen or more forecasters said it was going to do. The results are not without humor. In an average of the prophecies of fourteen agencies, 40 per cent proved true and 60 per cent never occurred. The best record was made by a national bank which scored 85 per cent hits. The worst was the most celebrated—or notorious—of the prophets, whose forecasts are accompanied by charts of such astounding complication and color that we have always doubted whether the maker himself knew what they meant. He was right 15 per cent of the time! One ought to do better than that with a ouija board. Some day there may be enough statistical information available to enable one to outguess the future. But even then it will be merely outguessing and there will be so many ulterior and unpredictable influences at work that it will be subject to the failure always inherent in a guess. To claim that any prediction made on the limited information now available is more than an expression of judgment comes pretty close to soliciting money on false pretenses.

Restricting Business Information

GENERAL business forecasting is so doubtful because the subject is complicated and because, too, all calculations may be thrown out of joint by unexpected national and international actions. To take the most obvious example, no prophet in the spring of 1914 knew that an assassination soon to take place in an obscure Serbian town would throw into the discard all the carefully built up data of past economic performance on which might have been predicated the forecasts of the business situation in the coming summer. On the other hand forecasting of a single business is simpler, and while subject also to the major ebbs and flows of economic conditions is most dependent on existing conditions in the trade or business itself. For that reason statistics of his trade or business—authentic and prompt—are the most valuable aids a business man can have in judging how much to produce. Such figures do not forecast for him the demand for his goods; that is something he must learn from other sources, but they do give him a line on the total supply and make less possible the slumps and booms due to ignorance of supply conditions. It is unfortunate, therefore, that the consent decree formulated by the Department of Justice in the tile manufacturers' case apparently prohibits a trade from collecting such statistics and throws the whole onus of such collection on the government. Up to date the government has not been prepared to provide the machinery or the funds, both necessarily large, to carry on such work. The interpretation of the Sherman Act as to trade statistics is running to absurd lengths.

Federal Aid for Roads

ENGINEERS and contractors need to keep in mind that the Congress now in session has before it the task of continuing or, as may be considered, of changing, the federal-aid road law and also of providing appropriations, if federal aid is to be available beyond the present fiscal year. Acting officially in convention the Association of State Highway Officials has asked for an allotment to the states of $100,000,000 a year of federal aid for a period of three years from June 30, 1925. This amount is not too great for the states to absorb if they get about the task of building roads. Just now their delay, or, more accurately, the delay of some, in matching the federal-aid funds and placing work under contract is furnishing the best excuse that Congress will have that appropriations may be reduced and that the present law needs changing. There will be other influences to swing federal activity in road building to a separate system of national highways, to sectional highway systems or to some other object than is contemplated in the present federal aid law. Direction of Congress has to come from engineers and contractors. They are organized to furnish it. The general public, though wanting roads and aid in roadbuilding, may not be expected to take direct action. Contractors' associations and engineers' societies have the important duty this winter of seeing that our present efficient plan of organization for federal-aid road construction is not changed without real reason and that the present liberal appropriations for roadbuilding are continued.

Chances in Garbage Disposal

TWO narrow escapes from the fate so common to garbage disposal plants present themselves for record. The cities are Wheeling, W. Va., and Sacramento, Calif. At Wheeling, a Balmer incinerator, the first of the kind in this country, was put under contract early in 1923. About the time the plant was completed a local election substituted one faction of the dominant political part for another. Straightway began the attempt common under such changes to discredit what had been done by the previous administration. The new Balmer incinerator was beclouded for some weeks but although a test made under the new administration resulted in a report indicating that the plant was far below contract capacity the incinerator was finally accepted. Possibly the local authorities learned of the failure of new city administrations of San Francisco and Atlanta, some years ago, to throw new incinerators onto the hands of the contractors. Both cities were beaten. Atlanta recognized it and has used the furnaces since. San Francisco has tried to make victory of defeat by letting the new incinerator stand idle for many years, while continuing to use destructors of another British type, built in the nineties.

The experience at Sacramento was different in detail, although there also an incinerator came no one knows just how near to abandonment, soon after if not before completion. Just as the plant was nearly ready comes a "senator" of mystery with a proposal to enter into a contract for garbage collection and disposal. The city was priding itself on its collection system it had recently established, and on its new incinerator progressing towards completion and use. Apparently the "senator" had considerable support for his scheme, so concerned were some of the city officials lest it be adopted. Opposi-

tion and questioning led to a modified proposal. The plan was not without attractions, since on its face, an operating charge was to give place to revenue for the city. What seemed to be a joker appeared in the revised offer, in that the city was to stand ready to take whatever refuse the "senator" and his friends saw fit to turn over for disposal in the incinerator, evidently at the city's expense. While this would have put the furnace in use as a "standby" it would have been immediate partial abandonment, at the least.

Such are some of the garbage disposal chances being taken in considerable numbers all over the country by cities and contractors alike. They will continue until both see that it is for their interest to have garbage disposal put on a sound engineering basis.

Earthquake Construction

MUCH information is afforded by the views of Japanese earthquake damage printed in this issue. These views, supplied by a number of Japanese readers of *Engineering News-Record*, show the effects produced on civil engineering structures of different kinds, effects which range from the cracking of buildings to the shaking apart of earth masses and bridges. Broadly, the showing agrees with that of other earthquakes; but it is much more important, because of the greater variety of the effects as well as the greater violence of the earthquake. The effect on the railways, especially the culverts, fills, trestles and bridges, as shown in the views—only a few of which can be given for lack of space—is much more severe than most American engineers have realized.

In considering how all such effects may be guarded against by the designer and builder, it is well to bear in mind that earthquake action is dynamic, while the usual structural problem and the methods of analysis applied to it are exclusively static. The difference sets up a formidable difficulty, particularly because the structural engineer will hardly be willing to subordinate his static analysis, which deals with the important service needs, to a radically different kind of calculation, applicable perhaps only once in the lifetime of his structure. The ready way out of the difficulty is to convert the data of the dynamic action into static terms. This course has been followed by the Japanese students of the subject, and is reflected in the brief summary of design principles presented in this issue.

So long as the equivalent static analysis remains well within the range of experience and embodies a fair safety allowance, it should lead to satisfactory results. Accordingly we may consider the general case of buildings to be within reaching distance of solution. Extensive data are furnished by observations on city buildings of structural engineering type. Extending these data to dwelling houses and special types of building may require much careful study, but should be thoroughly feasible. Thus, we may hope to render building construction reasonably secure against earthquake ruin —at least in theory; in practice it may not be found economically desirable to incur the cost of providing this security.

Other structures are not in the same favorable condition, however. Chimneys, high bridges and earthwork constructions come in this category, and these all present special problems that do not appear to be amenable to an equivalent static analysis. The case of the chimney is the simplest of these, and it does not seem impracticable to apply dynamic analysis to this particular problem.

The problems encountered in bridges and earthworks, however, are decidedly more refractory. Such structures are affected in puzzling ways by violent earthquake motions, as some of the illustrations show. It appears that a great deal of further study of shaking forces and resistances will be required before this part of the earthquake problem can be considered on the way to solution.

Financing Subway Construction

FOLLOWING closely upon the report of the Detroit Transit Commission recommending that the cost of new rapid-transit facilities be paid for by assessing the major portion of the cost on the local property which the subway benefits comes an independent recommendation from property owners along Sixth Avenue in New York City that the Sixth Avenue elevated railway be replaced by a subway financed by the property owners along the line. The Sixth Avenue property owners believe that the increase in the value of their property due to the removal of the elevated structure would more than repay them for the increased assessment.

The theory of assessing the cost of subways on the benefited property is not a new one. It is written into the present Rapid Transit Act in New York, but this is the first time that it has been proposed as a means of financing a specific piece of new construction. Its advantage is just as clear in New York as in Detroit, for, as we said in commenting on the Detroit plan in the issue of Dec. 13, the city is so near its debt limit that it is not in a position to finance all the needed rapid transit, nor are the people anxious to have the interest on the city debt continually increasing. Under the bond-issue plan there is little possibility of the city undertaking the replacement of the elevated structure for years to come. What money it can spend will be spent on building aditional subways. Financing by assessment makes possible an otherwise impossible piece of construction.

It has still another advantage. The cost of construction is a direct charge upon the property of shrewd business men who can be depended upon to see that the money which they raise is not spent in the lavish way in which city money is usually spent, nor will they allow a large part of it to be absorbed in paying excessive prices for property rights or supposed damages to abutting property.

In the case of the Sixth Avenue elevated replacement there are many difficulties in the way of carrying out the proposition, but fortunately it is backed by a group of business men who realize that the removal of the noisy and unsightly elevated structure will make Sixth Avenue second only to Fifth Avenue as a business street. The stimulus which this realization has given their efforts is assurance that the project will be undertaken in the near future. Their efforts will be watched with interest by the advocates of more rapid-transit facilities in all our large cities. There is no reason why the same method cannot be applied wherever lack of city funds or disinclination to spend them for such purposes prevent construction.

Earthquake Characteristics and Building Resistance

A Summary of Basic Laws and Constants Deduced From Measurements of Earthquake Motions, and Checked by Observation of Damage Done by Recent Severe Earthquakes

By R. E. J. Summers
Assistant Chief Engineer, H. K. Ferguson Co., Cleveland

During the past year the writer made a study of questions bearing on earthquake resistance of buildings, in connection with the design of a new plant for the Shibaura Engineering Works of Tokyo, Japan, for which the H. K. Ferguson Co. was consulting engineer. No literature in English being available, reference was made entirely to works of Japanese investigators. The works of the Imperial Earthquake Investigation Committee during the past twenty-five years constitute a treatise on the subject. An abstract of what they indicate, when taken in conjunction with observations on actual earthquake effects, is given in the present article.

To explain the problem in hand, it should be said that the Shibaura Engineering Works, a Japanese-controlled organization affiliated with the General Electric Co. and manufacturing similar equipment, decided to build a new plant modeled on best American practice. Plans were to be made in their offices by their own staff, the writer acting as consulting engineer and supervising and checking the plans and specifications. The plant will cost 50,000,000 yen, or $25,000,000. The first of the three construction sections, drawings for which have been completed, includes a heavy machine shop, 304x850 ft.; a forge shop, 186x200 ft.; a pattern shop, 70x300 ft., two stories high; and a warehouse, 70x400 ft., three stories high; together with a central heating plant, sewage disposal plant, and minor items. The machine shop will be twice as large as any factory building in Japan, and will be of steel frame, with large high spans and heavy cranes. The two multistory buildings are of concrete flat-slab construction.

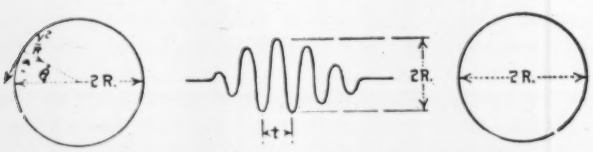


FIG. 1—SIMPLE HARMONIC MOTION IN EARTHQUAKE VIBRATIONS

Earthquake Period and Amplitude—An earthquake is a sort of simple harmonic motion (Fig. 1) similar to the projection of a circular motion on a straight line. If t is the time of travel of one circular motion, r the radius of the circular motion, v the speed of the circular motion, and a the acceleration toward the center of this circular motion, then

$$v = \frac{2\pi r}{t} \text{ and } max.\ a = \frac{v^2}{r} = r\left(\frac{2\pi}{t}\right)^2$$

Applying these terms to the earthquake movement, we have its acceleration, a, expressed in terms of its period t and its range of motion or double amplitude $2r$. Therefore, if from seismograph diagrams we read that with a period of 1 sec. the range of motion is 100 mm., then $a = 50\left(\frac{2\pi}{t}\right)^2 = 2{,}000$ mm./sec.²

Should unsatisfactory seismograph records be secured, the horizontal acceleration of the earth motion can be calculated from observing overturned objects, such as pedestals, tombstones, etc., by using the formula $a = xg/y$, in which g is the acceleration due to gravity, y the height of the center of gravity, and x the horizontal distance between the c.g. and the edge about which the body is overturned.

The force exerted by an earthquake on any structure can be expressed in terms of the weight of the structure, W, by the basic formula $F = Wa/g$. The coefficient a/g is called the *seismic coefficient*, denoted by K; the earthquake force F equals the dead weight multiplied by this coefficient. For example, if a = 2,000 mm./sec.², then $K = \frac{2{,}000}{9{,}800} = \frac{1}{5}$, so that the total force due to the earthquake = $\frac{1}{5}$ W, or $\frac{1}{5}$ of the dead weight of the structure.

Seismic Coefficients—Before the last quake, the Tokyo Weather Bureau had established the maximum seismic coefficient to be used in design at $\frac{1}{10}$, which is that caused by an earthquake with an acceleration of 1,000 mm./sec.² This is the recorded size of the great quake in Tokyo of June 20, 1894. The great quake at Nagoya on Oct. 28, 1891, however, had:

$$a = 2{,}600, \text{ or } K = \tfrac{1}{3}.$$

With these varying seismic coefficients, the designing engineer should consider the probable life of the structure on which he is working, the cost of it, and the cost of increasing his coefficient. Earthquakes in Japan occur apparently in cycles, with a great one every 60 years, like the one of Sept. 1, 1923, which was almost on schedule. With this in view it would seem probable that the use of $K = \frac{1}{5}$ would give ample protection for buildings now being built.

In a one-story building the force $F = KW$ is applied horizontally at the top of the sidewall, and stresses caused thereby are figured the same as for wind stresses. In a multistory building the lateral force is considered transferred by each floor and roof slab, and the stresses are calculated the same as for wind stresses.

It has been observed that an earthquake never occurs while the wind is blowing, but always in a dead calm. This was especially evident from reports of the latest quake, when the high wind prevalent in the morning quieted to a dead calm with oppressive heat just before the quake. Because of this it is not necessary to add the wind and earthquake stresses in securing the maximum stress.

Japanese Construction—From these considerations, it is evident that the lighter the building, especially in the upper parts, the less it will be affected by a quake. The typical Japanese building is exactly the reverse of this, and therefore is easily shaken down. They use a light, flimsy wooden structure, with a very heavy tile roof. The columns, joists and beams are mortised

FIGS. 2 TO 7—SIX VIEWS OF DAMAGE DONE IN TOKYO BY THE EARTHQUAKE OF SEPT. 1, 1923

Fig. 2—Maruzen Book Store; principal damage in upper part.
Fig. 3—Office of Andogumi; heavy tower thrown into street.
Fig. 4—Destruction of tile-roofed houses in Dozaka (street).
Fig. 5—Uninjured modern buildings; Ginza Building under construction.
Fig. 6—Stucco cracked off Mitsukoshi department store building.
Fig. 7—Asakusa ward; effects of fire after the earthquake.

together so that a column is so cut to pieces that one expects to see it break in two when being lifted into place.

As the streets are very narrow, the safest place to stand during a quake is under a lintel. Here one is protected from tile sliding off the roof, or from the roof collapsing inside. In a multistory office building the safest place is the center of the room, as the partitions are most likely to be thrown down, and the center of the room is equidistant from all walls.

Where Cracking Occurs—Every structure has a natural period of oscillation dependent on its shape, size and homogeneity. If this period of oscillation is longer than the period of the destructive earthquake motion, it can be classified as a tall column; if its period is shorter than that of the quake, it is a short column. The period of the destructive earthquake is 1.0 to 1.5 seconds. For a tall column, such as a brick chimney, the tendency to fracture will be at ⅔ of the height above the ground; in a short column, the tendency to fracture will be at the base. The multistory office buildings recently built in Tokyo come under the latter category. In the usual building of this type, the first story is so massive and so integral with the foundations that it can be assumed as part of the foundations, so that fracture would tend to be in the second story.

This was first proven in the earthquake of April 26, 1921, when the Marunouchi Building, then under construction, had almost every plaster in the second story cracked at an angle of 45 deg. Observation of the effect of the latest quake on the Palace Hotel, a building of same height, shows the steel column at the second floor offset 3 to 5 in. to the west and 5 to 10 in. to the north, and all of the second-story walls thrown down.

Overturning and Vertical Force—The stability of a building against earthquakes is proportional to its size and not its weight. If b and h are the breadth and height of the building, W its weight, and F the horizontal force tending to overturn, then the overturning moment is $\frac{1}{2} Fh$ and the stability moment is $\frac{1}{2} Wb$. Hence, when $Fh - Wb$ is greater than zero the building will overturn, and when it is less than zero the building will not overturn. Or, since $F = KW$, danger

or safety are indicated by K being greater or less than b/h.

Earthquake motion, though sometimes very violent, is continuous and does not consist of isolated jerks or shocks. The idea prevalent among laymen and some engineers that in destructive earthquakes buildings are first uplifted by the vertical motion, and then destroyed by being suddenly thrown downward is quite in error.

In ordinary cases the vertical component of the earthquake motion is much smaller than the horizontal. For instance, the severe Tokyo quake of 1894 registered a maximum horizontal motion of 73 mm., while the maximum vertical motion was only 11 mm. Therefore the damage was essentially due to the horizontal motion. This has been remarked in every quake recorded, so that we can assume that the vertical component is of secondary importance, and, except in cases of the foundation sinking, the entire damage is done by the horizontal motion.

The stability of a building is also affected less by the vertical motion than by the horizontal. This is shown as follows, using the same building and notation as above: If a' is the acceleration of vertical motion, then $\frac{W}{g}(g - a')$ is the effective weight when movement is down, and $\frac{W}{g}(g + a')$ is the effective weight when movement is up. The overturning moment due to horizontal motion $= \frac{Wah}{g\ 2}$ or $\frac{1}{2}KWh$, while the minimum stability, when vertical motion is down, is $\frac{W}{g}(g - a')\frac{b}{2}$. Therefore $\frac{Wa}{g}\frac{h}{2}$ must exceed $\frac{W}{g}(g - a')\frac{b}{2}$ for danger from overturning, or danger is present when $\frac{a}{g - a'}$ exceeds $\frac{b}{h}$.

Orientation of Building—Due to the shape of the range of mountains on the main island of the Japanese Empire, the direction of earthquake motion at Tokyo is always east and west. In making the plant layout for the project in hand, it was possible to put the length of the buildings east and west, making the bracing a more simple problem. On the machine shop and forge shop the roof deck was made of 2-in. dressed and matched Oregon fir supported on steel purlins, in order to secure a light, rigid surface that cannot crack and fall, be shaken out of position or slide off. All monitors are provided with continuous top-hung standard rolled steel sash glazed with ¼-in. wire glass, being light and giving light, and the wire glass making for safety in case it should be cracked. This combination of light roof with heavy columns required for the cranes approaches the ideal as to relation of component parts of a building for best resistance to earthquakes.

Due to the excessive wind on the coast line at the building site, the structures were designed for a 30-lb. wind load. The Japanese code, by the way, allows no increase in allowable stress for combined wind and dead-load stresses. Using the usual designing seismic coefficient ⅒, the total horizontal force proved to be less than one-third of the total pressure of the wind. These stresses not being coincident, the structure actually is proportioned for a seismic coefficient three times that assumed, or $K = \frac{1}{3}$, which is the same as that registered for the severe earthquake of 1891.

It is interesting to note that this checks the statement of the committee on buildings of the American Society of Civil Engineers which reported on the effects of the San Francisco earthquake of April 18, 1906 (*Trans.*, Vol. LIX, p. 208): "Sufficient evidence is at hand to warrant the statement that a building designed with a proper system of bracing to withstand wind at a pressure of 30 lb. per square foot will resist safely the stresses caused by a shock of an intensity equal to that of the recent earthquake."

Actual Earthquake Destruction—Generally the non-synchronizing in horizontal motion of the walls and roof is doubtless the principal cause of the destruction of brick buildings. It has been noted that one-story brick buildings are most damaged at the junction of the walls and roof, and that the two-story ones similarly are damaged most at the junction of the upper walls and the roof while the lower walls remain uninjured or little affected. This is evidenced in Fig. 2, showing a three-story brick building located on the main street in Tokyo. Again, in Fig. 3 the top of the tower rests in upright position in the street, indicating that the heavy top failed to synchronize with the walls and, the range of motion being quite large, was projected bodily into the street.

In Fig. 4, note the usual Japanese style of building, with the heavy tile roof, flimsy walls, with windows of light frames covered with paper, and a typical failure from earthquake.

Fig. 5 is a view of the Ginza (the only paved street in Tokyo, and the main business street) taken from Owaricho, the main intersecting street. Note the burned street car in the foreground. The exposed steel frame on the right is the new Ginza Building, twelve stories high, just under construction, and apparently plumb and safe, with only the concrete hoist tower askew. Incidentally, this steel was erected and being riveted in December, 1922, when the writer arrived in Tokyo; with work apparently uninterrupted, riveting was still under way in August, 1923. The uninjured concrete and brick building on the near side of the Ginza Building is also new. The large building in the distance, apparently in the center of the street, is the office of the Yokohama Life Insurance Co., of heavy stone masonry construction, and is about opposite the building shown in Fig. 2. The small wrecked buildings shown were of poor flimsy construction, likely to fall down with small excuse.

Fig. 6 is a view of the Mitsukoshi Department Store, a very modern and popular store, the showplace of Tokyo. The structure is of reinforced concrete. Its exterior walls are heavily scored to hold the stucco. In pouring concrete, the Japanese use soft unplaned wood forms and take no care in rodding and tamping the wet concrete. When forms are stripped, the surface of the concrete is full of voids, very rough, uneven, and covered with small splinters. Over this is placed a ¾-in. cement plaster coat, well troweled and painted with liquid hardener. As there are hundreds of small quakes every year, this plaster coat peels off every three or four years and has to be replaced. This picture also indicates the truth of the general observation that the main damage done in the recent disaster was by fire and not by earthquake.

Fig. 7 is a view of Asakusa ward in Tokyo, in which was located Asakusa park, Tokyo's Coney Island. Note the two concrete buildings and chimneys in the

background, with steel sash still in place. Also note that in all of these pictures the poles are still standing, being one piece of evidence that the quake was not so severe in comparison with previous ones. Thousands of buildings withstood the shock, only to be burned in the fire. This was especially true in Yokohama. The greater part of the homes on The Bluff (the foreign residential section) were much shaken by the quake, but still stood Saturday afternoon, only to burn later.

The writer is indebted for much of this information on earthquakes to the papers of the late Dr. F. Omori, Tokyo Imperial University, which were published in the Bulletin of the Imperial Earthquake Investigation Committee, and to his personal courtesy and help; also to Dr. T. Naitow, of Waseda University, Tokyo, for many of his articles and much advice and assistance in translation; and to P. K. Kishi, engineer for the H. K. Ferguson Co., for assistance in translation.

Earthquake Damage to Japanese Government Railways

Initial Injury to 68 Bridges Mostly Due to Failure of Piers and Abutments—Steel Structures, Rigidly Braced, Offered Greatest Resistance to Shock

By Mitsuo Nawa
Engineer, Government Railways of Japan, Toyko, Japan

FIRE, WHICH was so disastrous a consequence of the earthquake of Sept. 1 in centers of population, did little damage to property of the Government Railways of Japan, except to rolling stock. Most of the damage which spread over an area of 3,270 sq.mi. and made necessary reconstruction of 372 miles of line, was due to the shock itself. In this mileage were included 68 bridges which were injured. Thirty-two tunnels, of a total length of 2,855 ft. also sustained damage. Station buildings which burned included four of brick and thirteen of wood; twenty-two constructed of wood collapsed. An official report lists twenty-two train accidents caused by the quake, 53 locomotives burned or damaged, and 386 passenger cars, 817 freight cars and 31 electric cars burned.

Damage to Bridges—The damage to bridges comprised for the most part the cracking, displacement or complete failure of abutments and piers. Steel girders sustained slight initial damage. Typical of the shock's effect on bridges is what happened to the bridge over the River Banyu on the Tokaido main line. This consisted of two single-track structures each with 28 plate-girder spans 70 ft. long. The piers were of brick and hewn stone piled on elliptical hollow piers known locally as wells. These had a 12-ft. major axis and a 7½-ft. minor axis. Forty-four of these piers were broken at the point near the water line and fell downstream. The wells leaned and some of them shifted off center as much as 2 to 3½ ft.

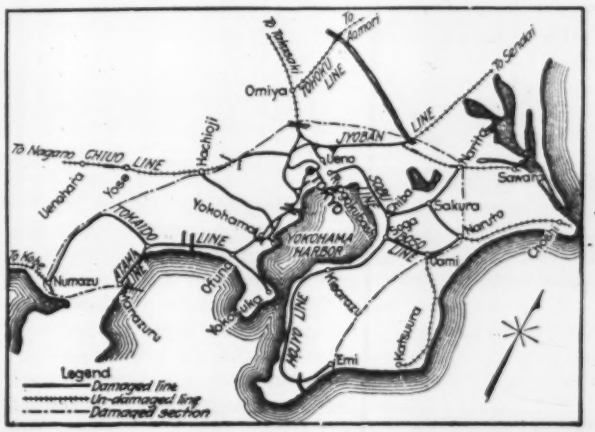
The bridge over the Sakawa River on the Atami line consisted of eight spans of double-track truss girders 150 ft. long, and two lines of 16 spans single-track plate girders 60 ft. long. The piers for the 150-ft. girders sustained no damage; the girders rested on reinforced-concrete cylindrical wells 14½ ft. in diameter and 30 ft. center to center, and the pier wells, sunk 50 ft. below the river bed, were concrete. Upon them concrete columns faced with masonry were built up to the bridge seat. The damage to this bridge, as shown in the accompanying photograph, was due to vibration, a span of truss girders 150 ft. long becoming unseated.

Considerable damage was sustained by bridges of the older type of construction where piers were connected by masonry arches. Absolute comparison of these structures with newer design was had at the crossing of the River Rokugo on the Tokaido main line. The railway bridge consisted of two lines of five spans of double-track truss girders 120 ft. long and four lines of 24 spans of single-track plate girders 44 ft. long. At the center an elliptical well with major axis of 21½ ft. and minor axis of 14½ ft. diameter was sunk and on either side a cylindrical well of 14½ ft. diameter on which piers, as in the case of the bridge over the Sakawa, had been separately erected. Of these piers only a single column was broken but slightly downstream on the Tokyo-Yokohama Electric Ry. Co. line all five piers were cracked at a point under the arch, that structure having piers connected by masonry arches.

There were no arch bridges of long span in the district sustaining heavy damage, but in the bridges of short span whether of brick or concrete, side walls were forced out by the lateral pressure and the arch ring was cracked usually longitudinally.

Damage to Embankments—Inasmuch as embankments and reclaimed land offered a very low resistance to shock, some which met the vibration at right angles were cracked longitudinally or wholly broken. In several instances earth and gravel behind abutments subsided, pushing abutments forward or making them lean so that at several points the track was suspended in mid-air. The subsidence of reclaimed land at the stations of Shimosoga and Odawara and at the wharves at Yokohama was remarkable. Due to this subsidence track was often bent vertically or sidewise and the buildings leaned or collapsed.

Landslides Produced—In some districts where severe tremors occurred as in the mountainous part of Hakone,



RAILWAY MAP OF JAPANESE EARTHQUAKE AREA; DAMAGE TO GOVERNMENT RAILROADS INDICATED BY SOLID BLACK LINE

steep mountainsides of rock or earth and sand cracked at several points. Cracks in turn led to permeation of rain water often causing landslides or flows of mud which buried or washed away houses, railways, forests and fields, and othewise inflicted serious damage. The Hakone mountain ranges which were covered with green before the earthquake, now show many barren patches.

The landslide which brought about the greatest disaster occurred just above Nebukawa station on the Atami line. It carried away the main station building, a passenger train then stopping there, plunging everything into the sea and killing more than 100 persons, including passengers and station staff.

The greatest mud flow occurred also near Nebukawa station, coming down along the upper stream of the River Shiraito and washing away the greater part of a bridge, together with its piers. This bridge was 105 ft. high and consisted of three 140-ft. truss girder spans and four 40-ft. plate-girder spans.

Damage to Tunnels—Greatest damage to tunnels consisted in cracks across the walls near portals produced by earth and gravel above the portal sliding down and pushing out the upper parapet wall. However, in some instances, the interiors of tunnels were damaged, though the damage occurred where there was a fault or where there was softer soil and less surcharge.

Elevated Structures Suffer—The elevated line of the Government Rys. through Tokyo in the downtown district is laid in soft ground. The greater part of the track has been built on arches of brick or reinforced concrete of 26 to 40 ft. spans, the foundation of which was made by driving in pine piles and reinforced-concrete piles about 50 ft. in length. Where the ground is weaker, reinforced-concrete slabs were put in instead of the masonry arches. Further steel plate girders were used over roadways and reinforced-concrete skew arches of 125-ft. span were built over the Sotobori Canal. This elevated line sustained practically no damage from the quake itself, a few plate girders alone being shifted. But as various articles were stored beneath the arches and slabs, these took fire and the inner bricks of the arches were affected by the intense heat losing their coherence and flaking off in thin layers. Fire damage to the slabs seems to have been very slight.

The elevated line at Yokohama was laid upon an embankment. In one section a vertical concrete retaining wall was used on each side and in another section a similar wall was used on the one side and the slope was sodded on the other. The intermediate fillings sank a few feet and the retaining wall either was forced out vertically or leaned slightly forward. Owing, however, to the fact that expansion joints were used at 33-ft. centers, no damage was suffered by the wall at any particular point.

Buildings—The main building at the Tokyo station, a three-story steel-frame structure with brick walls, sustained no damage in spite of its size. The main buildings of Manseibashi, Shimbashi and Yokohama stations were two-story brick structures. They were gutted by fire, but remaining walls show no trace of earthquake damage. The fan-shaped reinforced-concrete engine houses at Shinagawa and Yokohama were built upon reclaimed land and have been cracked at several points, as at beam joints.

The majority of the cast-iron columns supporting the roof over the passenger platforms at Tokyo station were broken and fell. There were many wooden main buildings, sheds or storehouses which collapsed at local stations, among which may be mentioned the reinforced-concrete freight shed at the Takashima yard.

Rolling Stock—Most of the rolling stock destroyed by fire was standing in the station yards of Ueno, Tokyo, Shiodome, Iidamachi and Akihanohara. Other chief damage to rolling stock was due to derailment caused by the earthquake.

Conclusions—Conclusions to be drawn from minute examination of damaged property are:

1. The extent of damage to works and structures varies with the distance from the seismic center, the topography and the nature of the soil of the locality affected, method and character of construction and material, etc.

2. The resistance to vibration offered by embankments and fills is low so that construction of any high earth dams or of any structures built upon embankments which span both firm and weak strata should be carefully executed.

3. Brick or masonry generally offers low resistance to earthquake shock. In Tokyo some brick buildings of less than five stories suffered no damage, but they were built upon good ground or upon satisfactory foundations.

4. Resistance to earthquake of plain concrete work seems to be nearly the same as that of brickwork.

5. In general, steel structures offer a high resistance to earthquake shock. Steel framed buildings with reinforced-concrete walls have offered excellent resistance to shock. Just below them are steel frame buildings with good brick or hard stone curtain walls. Any buildings having hollow brick or terra cotta curtain walls sustained severe damage and the walls between windows showed large cross-shaped cracks or else the bricks fell out completely. Where bracing was insufficient steel columns were often found bent. It seems that there were not a few steel structures wherein rigidity had not been fully considered, failure consequently resulting.

6. In point of resistance to earthquake, reinforced concrete comes next to steelwork. Generally, also, reinforced concrete proved excellent against fire.

7. Wooden houses, of less than three stories and those roofed with light materials, offer a fairly high resistance to earthquake shock.

* * *

Other Comments on Structural Damage

IN A brief letter to *Engineering News-Record* K. Koyanaga, engineer in the Yokohama harbor engineering office of the Japanese Department of Home Affairs, explains that about 3,500 ft. of the breakwater of that harbor sank beneath the low water line. The quay walls, of gravity retaining wall type and constructed principally of large-size concrete blocks, were overturned or shifted, resulting in some cases in complete failure of piers and pier sheds. Many of the sheds were burned.

One of the curious effects of the shock is shown in the view herewith, sent in by Mr. Koyanaga. The statue of Iikamonnokami was turned on its base through an angle of 45 deg., although neither base nor statue was badly damaged.

Several interesting findings regarding earthquake resistance were developed from an examination of buildings in the affected area by Daniel O. Larsen,

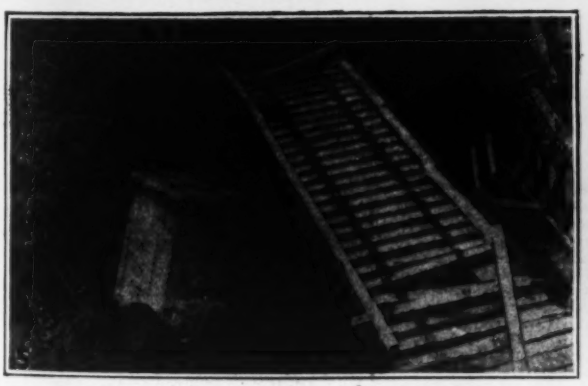


FIG. 1—BANYU BRIDGE ON TOKAIDO MAIN LINE
Structure of two single tracks of plate girders completely wrecked through pier failures.

FIG. 2—BRIDGE OVER ROKUGO ON TOKAIDO MAIN LINE
Broken pier supporting end of 120-ft. span.

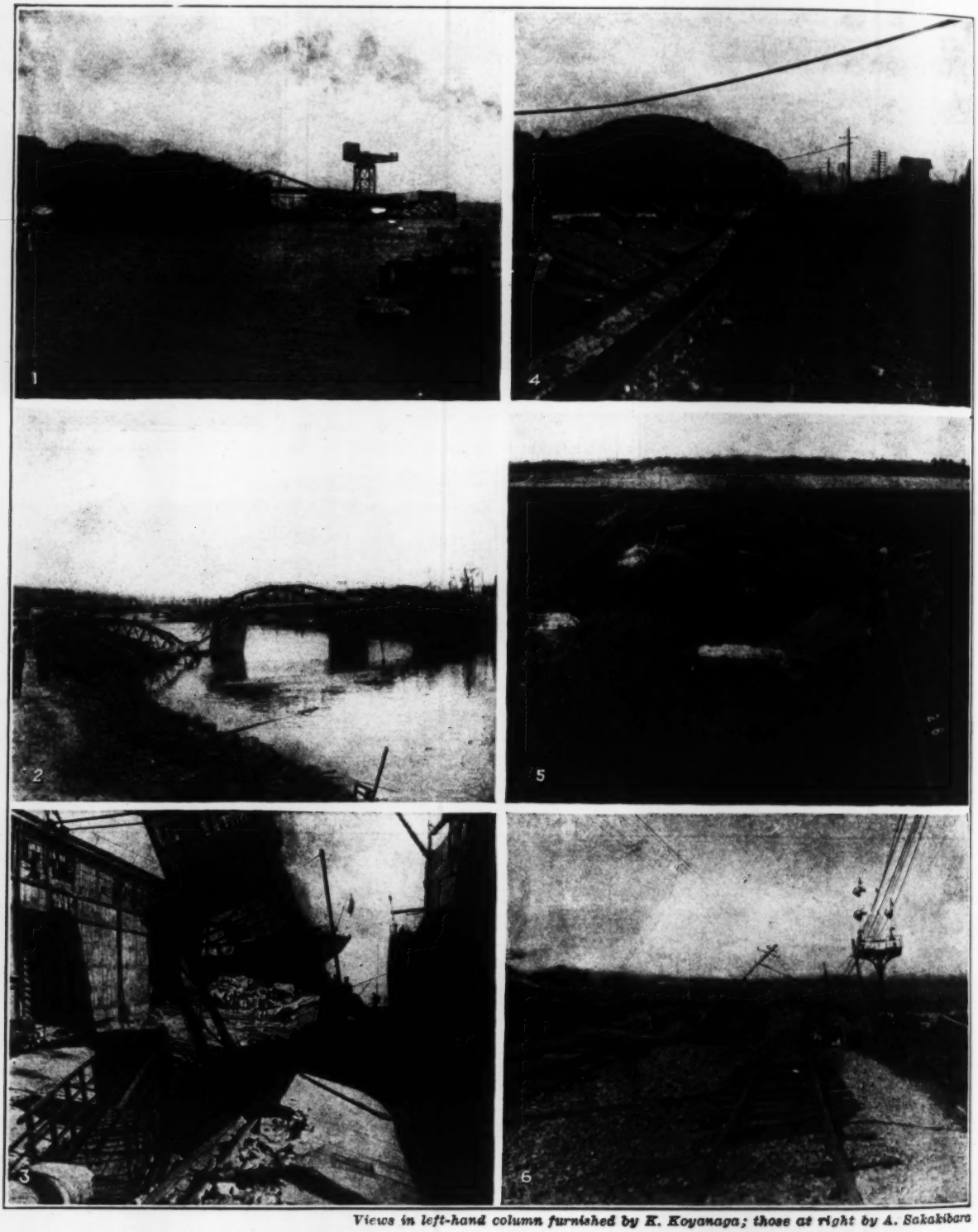
FIG. 3—ARCH CULVERT ON TOKAIDO MAIN LINE

FIG. 4—BRIDGE OVER SAKAWA ON THE ATAMI LINE
Failure occurred through double track truss girder span, 150 ft. long, becoming unseated and falling on its side.

FIG. 5—SHIRAITO BRIDGE ON THE ATAMI LINE
Landslides caused the failure here of two spans of double-track truss girders, 150 ft. long, and three 40-ft. spans.

FIG. 6—SHOCK EFFECT ON A FILL ON ATAMI LINE

The article by M. Nawa comes in reply to a letter sent its Japanese subscribers by Engineering News-Record. On page 1050 are shown photographs supplied by H. Sakakibara, manager for F. C. Kogiqsho, reinforced-concrete designers and builders of Tokyo, and by K. Koyanagi, of the Yokohama harbor engineering office, Department of Home Affairs. Acknowledgment is also made of letters from Ichiro Goto, engineering department, Daido Electric Power Co., Nagoya, and from R. Ono, Morioka Ry. office.—EDITOR.



Views in left-hand column furnished by K. Koyanaga; those at right by A. Sakakibara

FIG. 1—COLLAPSED QUAY WALL, YOKOHAMA
FIG. 2—WRECKED BRIDGE SPAN, YOKOHAMA
FIG. 3—YOKOHAMA PIER; WALL ALONE DAMAGED
FIG. 4—RAILWAY STATION NEAR TOKYO
FIG. 5—PLATE-GIRDER RAILWAY SPANS OVERTHROWN
FIG. 6—RAILROAD SHOWS EXTENT OF UPHEAVAL

architect, of W. M. Vories & Co. Mr. Larsen's inspection was made in company with several engineers of the Takenaka Co. and the Truscon Steel Co., and covered about thirty modern buildings in Tokyo and Yokohama. Many of their observations were directed to fire resistance. As to earthquake resistance the following points developed:

Continuous-slab reinforced-concrete foundations stood

the effects of the earthquake in almost every case, whereas buildings with individual spread footings went to pieces. This was illustrated in the Kogyo Bank building, the Imperial Hotel, Mitsubishi building 27, several of the Marunouchi buildings, and others, which show practically no damage.

Exterior walls were not damaged above the sixth floor, even when hollow tile was used. Reinforced-concrete or solid brick curtain walls are necessary up to at least the sixth floor, however. The Kogyo Bank, which shows no damage, has a reinforced-concrete wall up to the third floor and all corners have reinforced-concrete curtain walls; other walls are brick. Another building which shows no damage has solid brick curtain walls.

Solid partitions are favorable to earthquake resistance. Partitions of reinforced concrete or brick running through a building seemed to add noticeably to its resistance. It was also concluded that ceiling heights should be as low as possible.

Exterior finish will crack in proportion to the strength of the structure. Two buildings which had granite finish in the first three stories and terra cotta above, the Nippon Sekan and the Kogyo Bank, were affected differently. The former was seriously damaged by cracking of both the stone and the terra cotta; its frame comprised steel columns incased in brick and hollow tile. The other building had steel columns incased in concrete (and a better foundation) and showed no cracks in the stone or terra cotta.

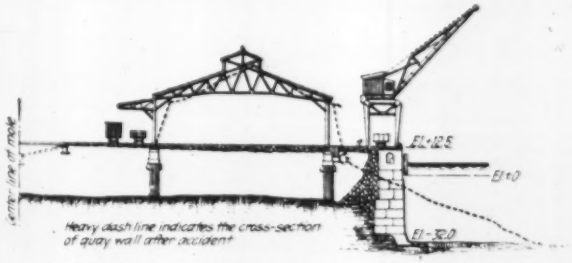
Conclusions as to earthquake resistance have also been given by R. F. Moss, vice-president of the Truscon Steel Co. of Japan. They are:

1. Floors and roof should be made as light as possible, to reduce the earthquake forces imposed on the walls and columns which carry them.

2. Walls and columns should be proportioned for transmitting the earthquake forces to the whole construction above.

3. Large open floor spaces unsupported by walls and partitions should be avoided, so that sufficient wall and column strength may be available. The Marunouchi building suffered less in the 1923 earthquake than in the much smaller 1922 earthquake; in the interim the hollow-tile partitions had been replaced by concrete and cement plaster partitions, the columns had been strengthened, and bracing added, the large floor areas thus being divided into small units each supported by strong partitions.

YOKOHAMA STATUE TURNED 45 DEG. ON BASE



SECTION OF YOKOHAMA QUAY WALL AND PIER

In steel-frame buildings the lateral strength of the steel columns is of secondary importance. Most of the work of transmitting the horizontal earthquake forces to the upper parts of the building must be done by the masonry walls and not by the steel columns. The buildings of the Nippon Oil Co. and the Nippon Yusen Kaisha had unusually strong columns, especially designed to resist earthquakes, but the walls of these buildings suffered more damage than did the walls of the Tokyo Marine Insurance Co. and Marunouchi buildings, which were designed much lighter but had stronger walls.

4. Good workmanship is of primary importance. Well laid stone walls suffered little. The behavior of brick walls seemed to depend on the workmanship and quality of the brick and mortar. Well-built reinforced-concrete walls came through with practically no damage.

5. All parts of the foundation should be connected together by members strong enough to make the various parts act and move together. The partial failure of the fifteenth bank building in Yokohama is chargeable to violation of this requirement. All of the center columns were not connected to the outside walls, and the horizontal displacement of the foundations was not uniform.

6. In tile roofs, every tile should be individually secured so that it cannot slip during an earthquake.

Engineers For Traffic Study

The Philadelphia *Evening Public Ledger* recently commented upon a problem of interest to engineers as follows:

"Mayor-elect Kendrick is wise in assuming that he might begin his administration well by submitting the whole problem of traffic congestion to a Board of Engineers. The traffic problem has been left to run rather wild. The police do their best with the facilities at their disposal, and, all things considered, they do amazingly well. But the pressure of motors in the narrower streets is leading to something like a deadlock.

"Neither automobiles nor trolley cars can move freely during the morning and evening rush hours. Indeed, the streets no longer serve the purpose for which they were intended. Business is being slowed up in many areas. It may be too much to suppose that engineers could find a prompt and easy way out of the dilemma in which the city finds itself. But they could at least lay the foundations of a scheme by which, as we go along, science may be applied to a problem which haphazard methods have failed to solve."

Hydraulic Tests of Flap Valves on Drainage Pipe Outlets

Determinations of Angles of Repose and Loss of Head in "Calco Gates" — Head Loss Slight and Leakage Small With Closed Gate

By Prof. Floyd A. Nagler

Department of Hydraulics and Mechanics, State University of Iowa, Iowa City

GATES of a flap or shutter type are often installed at the outlets of drains serving low-lying lands and tidal marshes. Manufacturers have claimed that such gates offer little or no obstruction to the normal flow of the water in the drains toward the water course since only a small force is required to open the gate. However, when the water in the main water course

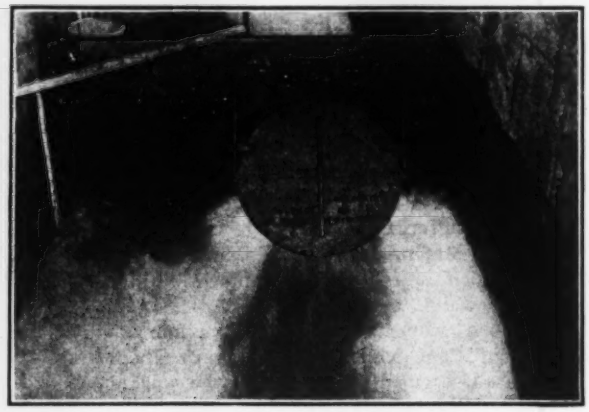


FIG. 1—A 30-IN. CALCO FLAP VALVE DISCHARGING 29.8 SEC.-FT. FREELY INTO AIR

rises to flood stages and stands higher than that upon the land itself the gate is forced firmly against its seat preventing the inundation of the land by water from foreign sources.

During November, 1922, experiments were performed at the hydraulic laboratory of the State University of Iowa to determine the actual amount of head lost through gates of this type. Double-hinged cast-iron flap gates of the "Calco" type (manufactured by the California Corrugated Culvert Co.) were secured for these tests, in sizes 18, 24 and 30 in. in diameter. Fig. 1 shows one of these gates operating with free discharge at the outlet.

The loss in head through each gate was observed with outlet velocities of from 1 to 8 ft. per second, while the corrugated pipe to which the gate was attached flowed either partially or entirely full, and with the jet at the outlet discharging freely in the air or entirely submerged.

The gates were attached to the end of a 10- or a 12-ft. length of Armco corrugated-iron pipe of the corresponding diameter in the hydraulic canal. By means of piezometer connections at intervals of 2 ft. throughout the entire length of the pipe, and hook gages installed in the basin above the inlet of the pipe, the hydraulic gradient was observed when the shutter of the gate was raised clear of the jet issuing from the outlet. The gate was then lowered so that it floated in a natural position and the hydraulic gradient was again observed, care being taken that the same quantity of water passed through the outlet as in the first case.

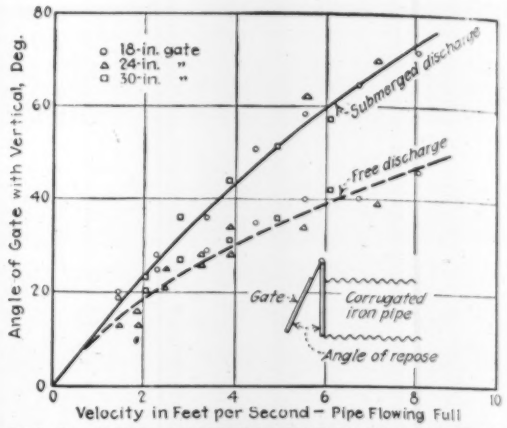


FIG. 2—ANGLE OF REPOSE FOR FLAP VALVES AT VARIOUS FLOW VELOCITIES

The difference in the elevation of the hydraulic gradient at points upstream from the gate was taken as a measure of the loss in head through the gate. The volume of water discharging through the gate was measured by a 5-ft. Bazin weir.

The loss in head caused by a gate of this type is obviously dependent upon the amount of obstruction caused by the shutter, and this in turn is dependent upon the angle at which it hangs. If water flows through the outlet at a high velocity the shutter is forced outward so that it rests almost horizontally, causing but little obstruction to the flow of water from the outlet; but if the water issues at a low velocity the shutter falls to a more nearly vertical position. The angle which the shutter makes with the vertical for the various gates tested was found to be practically identical and is shown graphically in Fig. 2 for the condition of both a free and a submerged outlet. Thus with the outlet flowing full with a mean velocity of 6 ft. per second the shutter rests at an angle with the vertical of 39 deg. if the jet discharges freely into the air, whereas the angle is 60 deg. if the gate is submerged. It proved possible to verify theoretically the results shown by these curves by computing the moment of reaction of the jet issuing from the outlet and equating it to the gravity moment of the shutter.

The loss in head caused by any gate proved to be less than 0.01 ft. under all velocities of flow when the water discharged from the outlet freely into the air. The loss in head with a submerged outlet (Fig. 3) is greater. For all three gates a maximum value was

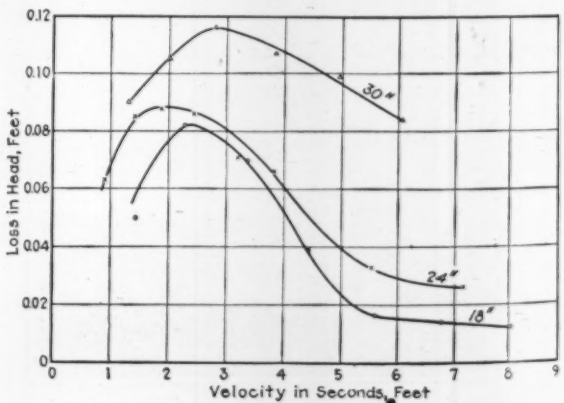


FIG. 3—LOSS OF HEAD DUE TO FLAP VALVES

reached when the velocities of flow were between 2 and 3 ft. per second, in which case the shutter hung at angles between 23 and 34 deg. with the vertical. The loss of head in all experiments proved small, reaching a maximum of 0.116 ft. for the 30-in. gate.

The 30-in. gate was tested for leakage when firmly held against its seat by backwater in a testing flume. The maximum leakage with heads varying from 1.6 to 4.5 ft. on the center of the gate was 0.015 ft. per second, the quantity decreasing with increase in head because the greater the pressure the more firmly was the flap held against its seat.

It may be concluded from these experiments that the loss of head through a gate of the Calco type is very small indeed and that such gates have but little effect upon the discharging capacity of drainage outlets. Also, if they are kept free from twigs and debris and properly installed, they may be depended upon to stop effectively the inflow of backwater.

Two Trips of Mixer Construct Four-Way Pavement

Fifty-Foot Reinforced-Concrete Park Road Pavement Has Three Longitudinal Construction Joints Doweled Every Three Feet

By John J. Murphy
Engineer, Park Department, Boston, Mass.

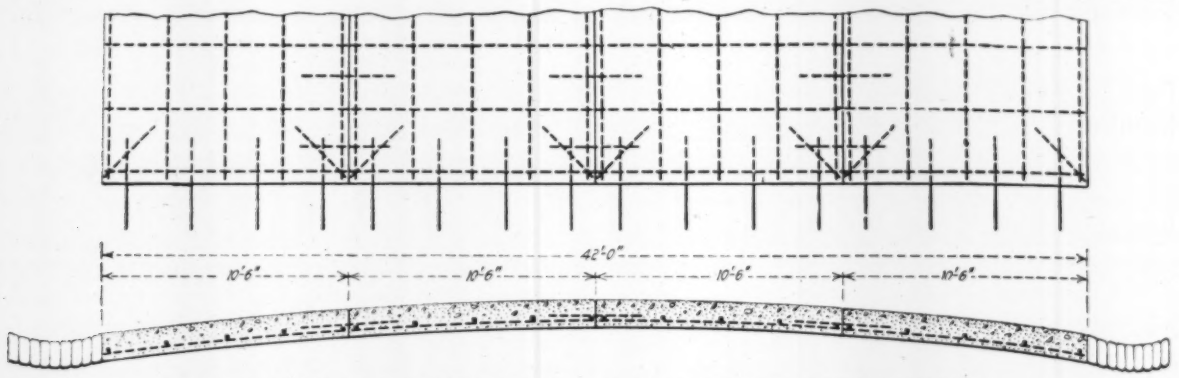
A 42-FT. concrete road has recently been constructed in four strips on a portion of Commonwealth Boulevard in Boston. This road carries practically all of the traffic between Boston and western Massachusetts and the pavement was made wide and thick and was heavily reinforced. Its construction was remarkably simple, only two trips of the paving mixer being required to build the four 10½-ft. strips. The 4-ft. gutters are granite block and make the road 50 ft. wide between curbs. Altogether 3,300 ft. of road were constructed.

The original road was crushed stone macadam with a Telford base and had a crown varying from 18 to 20 in. This excessive crown kept the motorists in the middle of the road with disastrous results to the central portion. It was decided to reduce this extreme crown so that the full width of the road could be used with comfort and no danger. Cutting down of the crown to 8 in. was accomplished by excavating at the center of the road and filling at the sides. This was a very difficult task on account of the Telford base, which it was desired to keep intact as a foundation for the new concrete road. It was accomplished with a shallow-cutting steam shovel which loaded into motor trucks. When shaped and rolled the old construction gave for the new concrete road a foundation of Telford and crushed stone with enough sand distributed on the stone to fill the surface voids.

The concrete was 7 in. thick at all points and was a 1:2:4 mix, using washed sand as a fine aggregate and washed gravel ¼ in. to 2½ in. for a coarse aggregate. The pavement was divided into four longitudinal strips, each 10 ft. 6 in. in width. These longitudinal strips were laid in alternate pairs. The mixer traveled on the subgrade and laid a strip on each side as it advanced. When the further end of the road was reached, the mixer was brought back and, traveling on the surface of one of the strips already in place and cured, laid the remaining two sections. The concrete was first screeded with a templet of wood, covered with tin, after which it was rolled with a light metal roller and them belted with a canvas belt. After the initial hardening had taken place, the surface was scored with brooms in order to roughen it and afford a better grip for traffic.

As the drawing shows in detail, the road was reinforced with ½-in. square steel rods, 2 ft. 6 in. on centers, both longitudinally and laterally. These rods were all placed in the bottom of the slab. They were made up in mats, all wired together, the transverse rods 10 ft. 2 in. in length, and the longitudinal rods 12 ft. in length. One-half inch square dowels 4 ft. long were placed in the center of each slab, 3 ft. apart, at the transverse and longitudinal joints. One-half of the dowel was left rigid in one slab and the other half was painted with asphalt. A ½-in. square rod 3 ft. long was placed in each corner and at the top of each slab. These corner rods were placed at 45 deg. to the joints. At each transverse joint elastite joint filler ½ in. thick and 8 in. wide was used. The transverse joints were placed 60 ft. apart. The faces of the first concrete strips poured were

TRANSVERSE JOINTS DIVIDE PAVEMENT INTO 10½X60-FT. SLABS

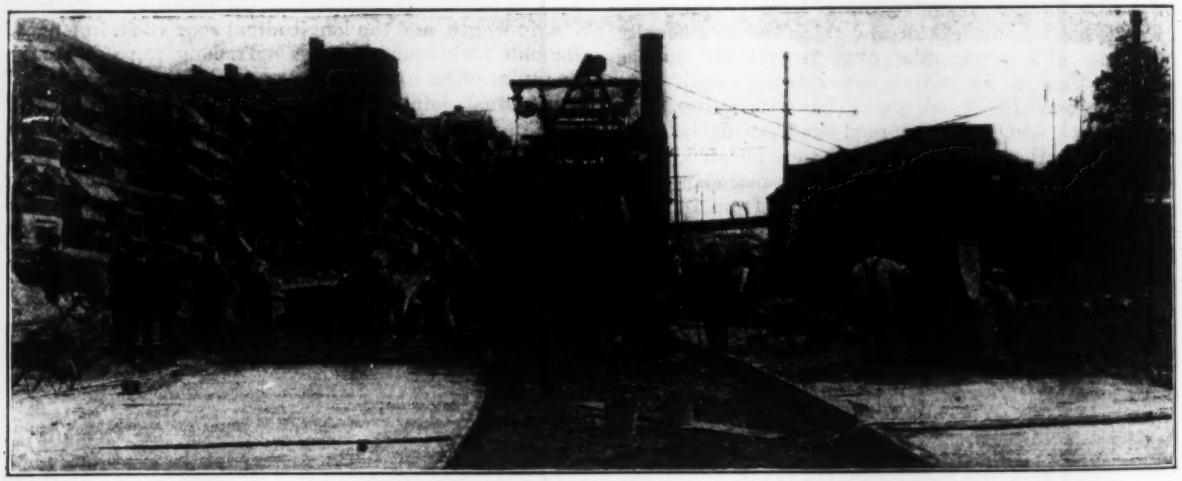


SECTION AND REINFORCEMENT PLAN OF FOUR-STRIP CONCRETE ROAD

painted with asphalt before the final two strips were poured. After being placed the concrete was protected by canvas and thoroughly covered with earth, which was kept moist for a period of ten days after laying, when this covering was removed. The road was finally opened for travel two weeks after the last section was poured.

A two-bag paving mixer was used and a day's run consisted of laying two parallel strips each 10 ft. 6 in. wide and 240 ft. in length, totalling 109 cu.yd. Metal forms were used throughout the work.

The road has been banked at one curve and the gradient at this curve is 7 per cent. This required considerable revision of old grades and much excavation in order to change the excessive crown to a banked section.



FOUR-STRIP PAVEMENT UNDER CONSTRUCTION

The result obtained is a very even riding surface, the pavement having riding qualities of remarkable excellence. The lowering of the crown, the elimination of crowns and depressions at intersecting streets and the banking of the sharp curve has made this section of the boulevard for its entire width, not only safe against skidding but pleasant to the man who drives a car.

The cost of the concrete road surface was as follows:

Concrete, per sq.yd.	$2.71
Steel, per sq.yd., 8 lb. at $0.05½	.44

The cost of the entire improvement was $74,000.

The contract for the improvement was let by the Boston Park Department to A. G. Tomasello & Son of Boston. The work was started May 10, 1923, and the road was opened for travel August 2, 1923.

Investigates Power on Green River, Wyo.

Recent investigations of the water power resources of tributary streams to the Colorado River by the Department of the Interior have included detailed studies of the possible power site on the largest tributary, the Green River, which has its source in glaciers and glacial lakes on the west coast of the Wind River range near the Continental Divide. The investigations show that probably nine of these lakes, having a combined storage capacity of more than half a million acre-feet of water, may be utilized as reservoirs for irrigation or power generation. The basin of the river above the town of Green River, Wyo., covers about 18,000 sq.mi. of land in the southwestern corner of the state, ranging in elevation from a mile to 13,800 ft. above sea level. Some of this land is already irrigated, and about 400,000 additional acres may be brought under irrigation. The report, which contains maps and photographs, shows the physical features and the meteorological conditions in the basin and describes ten possible power sites. Copies of it are on file in tha Geological Survey office in Washington and at the district office of the Survey in Salt Lake City.

Reconstruction of Hell Gate Dam to Eliminate Silt

Silt Deposits from Montana Smelter and Mines Controlled by New Low-Level Sluice Gates—Replacing Eroded Wall Difficult—Mat Protection Placed in Front of Wall

PONDAGE silt back of the Hell Gate dam of the Missoula, Mont., Light & Water Co., had by 1919 reduced the storage capacity, in the dozen years the hydro-electric plant had been in operation, to such an extent that the peak-load carrying steam auxiliary was being called upon more and more frequently. Four large sluice gates were installed to draw water from the river-bed level in 1919 by means of which the silt

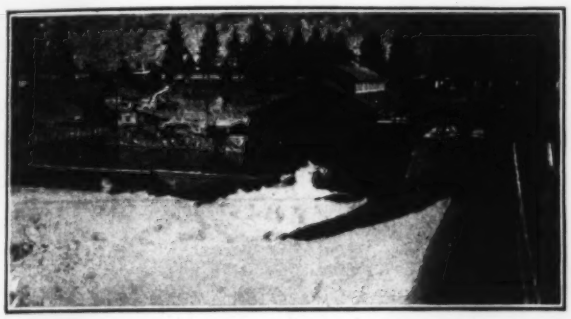


FIG. 1—HELL GATE DAM WITH NEW SLUICE GATES AND WALL

Back eddies from discharge several times undermined old crib wall between river and tailrace. Finally new concrete wall was constructed and base rock protected by thick mat of concrete in front of wall.

deposit could be eroded away during flood periods. The concentrated flow and eddy currents from the gates led to serious undermining of a timber crib training wall between the tailrace and the gate discharge. Reconstruction of this wall in three sections was completed early in 1923. The difficulties encountered in maintaining the old crib wall from base erosion, and finally replacing the crib with a concrete wall and mat protection of the rock in front of the wall have kept the operating officials of the power plant and a consulting engineer busy almost continuously for the past three years.

The hydro-electric plant and dam is located just below the confluence of the Hell Gate and Blackfoot Rivers. The Butte copper mines and the Anaconda Copper Mining Co.'s smelter are located 120 miles upstream on the Hell Gate River. Mine-pump and wash-water discharge from these mines, tailings from the smelter together with soil eroded from the bed and banks of the river, nearly displaced the reservoir water capacity. The intakes ahead of the trash racks had become so clogged as to seriously cut down the flow of water to the turbines. In 1919 the company decided to undertake measures for disposing of this silt accumulation and keeping it down.

The mountainous nature of the drainage area above this dam and the heavy snowfall at high elevations result in occasional heavy spring flood discharges of long duration. On one or two occasions the discharge has been known to reach 9 or 10 ft. over the crest of the dam, approximately 35,000 sec.-ft. The dam is of timber construction with a spillway length of 274 ft., the crest of which is fitted with 6-ft. hinged flash gates.

Sluice Gates—It was decided to install in this dam four sluice gates 9 ft. wide and 14 ft. high, at the end nearest the power house where the gates would be accessible and one gate could draw its supply from in front of the trash racks. These gates with their supporting walls took up 53½ ft. of the spillway length, leaving a clear spillway of 220½ ft. Under a normal static head of 31 ft. the gates and the spillway were found ample to take care of flood waters. The gates discharged approximately 13,000 sec.-ft. and proportionally more as the head increased. The spillway under 10-ft. flood discharged approximately 28,000 sec.-ft. The full requirement of the prime movers is 1,600 sec.-ft.

The plans and photographs indicate the general type of construction of the gates. The right-angle turn given the intake for Gate 1 was for the purpose of drawing its supply directly from in front of the trash racks. The upper end of the opening leading to this gate was closed off with a wall built from the top down to within 14 ft. of the floor, thus producing a current at the bottom for clearing silt and débris from in front of the racks. The other three gates draw their supply directly from the pond.

The procedure for wearing down the deposit over the ¾-sq.mi. area of the pond contemplated the use of these

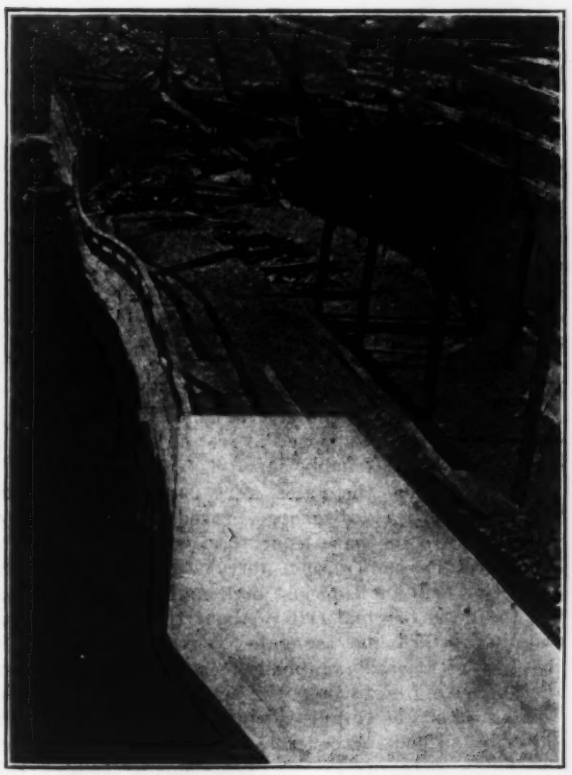


FIG. 2—CRIB WALL PROTECTED BY SHEET-PILING UNDERMINED

gates at intervals, when the accumulations warrant their use, during high river discharge periods only. The operation of these gates for silt cutting is as fol-

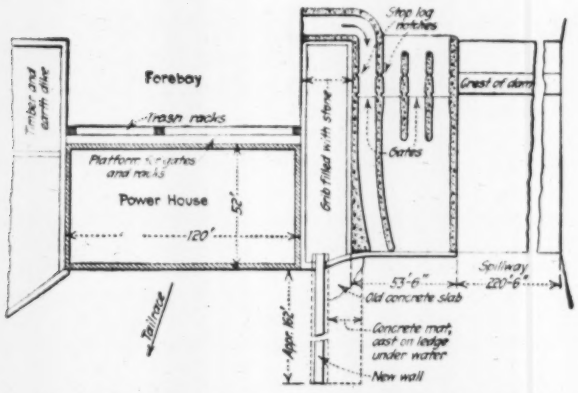


FIG. 3—TIMBER CRIBS AND NEW DIVERSION WALL

lows: Water in the pond is drawn down as quickly as possible to within a few inches of the silted surface, by dropping the hinged flash gates on the dam crest and opening the sluice gates. By manipulating the gates the pond surface can be brought to a ripple or to a high velocity over the silted area which tends to wear down the silted surface. This procedure lowers the head on the prime movers some 6 ft. for the time and during peak-load hours may call for the use of the steam auxiliary.

New Diversion Wall—Due to the location of the power house so far out in the river it was necessary to construct a diversion wall of some size to separate the tailrace from the river. This wall consisted of timber cribs, bolted together and filled with rock and gravel, and was supposed to rest on rock ledge, although no plans of its construction were on file. The crib had been repaired or rebuilt several times in the past fifteen years. About two years prior to the installation of the gates the second crib based on the native ledge was built alongside the original one on the river side. The new crib was filled with heavy rock, some of which weighed several tons, extending well above the surface.

In locating the gates at the power house end of the dam it was expected that the discharge might eventually dislodge a part of the new crib, although the discharge from the gates, due to the design of the guiding walls below the gates, was partially directed toward the middle of the river. Since the original crib diversion wall was supposed to rest on solid rock it was believed to be reasonably safe.

The first time the gates were used for the spring flood in 1920, their discharge proved to be much more destructive to the base ledge than was expected. The severe return eddies soon tore out the heavy stone protection crib addition last built and began undermining the main original crib. About this time the flood waters subsided and the gates were closed. Later in the year an attempt was made to stay temporarily further undermining, due to the action of the eddies, by driving steel sheetpiling along the river face of the old crib and pouring concrete back of the piles. When the gates were opened the next spring (1921) this sheeting was soon undermined by the ledge disintegrating and letting the water work up under the old crib. The gates were closed and a decision was reached that all further work should be of a permanent nature. As diamond drilling was deemed too expensive, it was decided to proceed with the work of unwatering the site and then accommodate the designs of the new concrete wall to the conditions found. From soundings the rock was found to be stratified and easily broken, but no knowledge was gained as to the thickness of its strata or its homogeneity. The water depth taken 40 to 50 ft. downstream from the gate apron and 10 ft. out from the old crib was 32 ft., and 4 ft. below the gate apron it was 16 to 21 ft. The old crib had a width of 32 ft., its top was 10 ft. above normal river level and its base 16 to 18 ft. below water level.

The designs called for a wall about 162 ft. long with an 8-ft. base, battered to 5 ft. at the top, and about 30 ft. high, on the assumption that the base ledge was 17 ft. below normal water level. The wall was to be cast in 33-ft. sections, separated by expansion joints and reinforced with steel bars partially for temperature strains but chiefly for surface protection from the pounding of logs. Due to the probability that the underlying ledge would prove insufficiently hard to resist the wearing action of the water, the original designs of the wall contemplated the use of reinforced

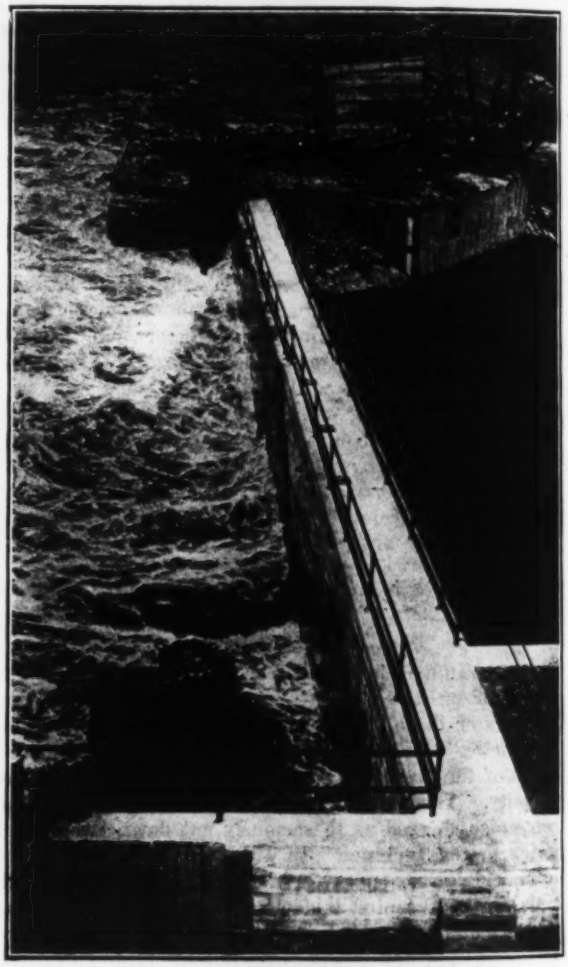


FIG. 4—NEW CONCRETE WALL WITH BASE PROTECTION

precast concrete piles 10 in. in diameter, varying in length from 8 to 14 ft. and spaced 6 to 8 ft. on centers, located on the river side of the center line of the wall base. Holes 12 in. in diameter were to be drilled in the base ledge and the piles dropped and grouted into

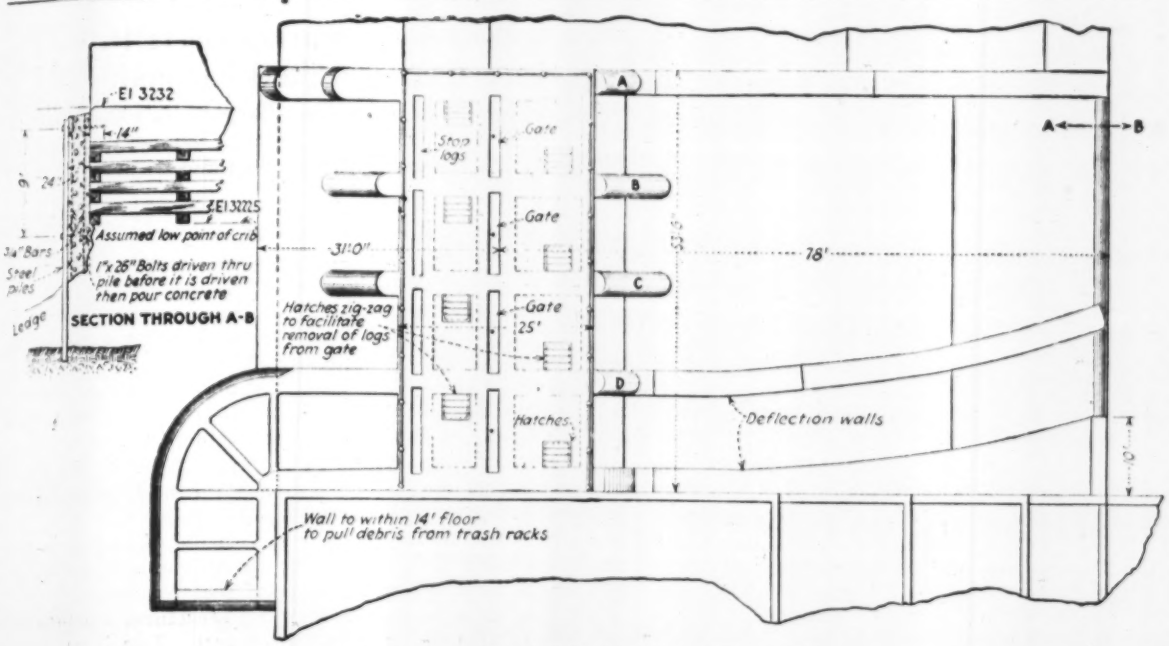


FIG. 5—NEW SLUICE GATES IN HELL GATE DAM

place, their function being to support the wall in case of partial undermining. Conditions at that time indicated that the river side of the wall base would be located about 8 ft. back from the edge of the rock ledge sloping rapidly downward toward the river. Should the rock prove to be of a nature easily disintegrated, the piles would render the wall stable until a concrete facing against the base ledge could be laid. The plan of using the piles was found to be impractical. No drilling in the base rock was done, but cores were provided in the wall itself from base to top, through which at a later date, if necessary, drill holes could be made and the piles used.

In the building of the new wall, three serious factors in its construction could be anticipated: (1) The old crib was in the way. (2) It was sure to be difficult to get through the crib to the base rock and exclude the water in the meantime. (3) Security must be provided against further underwash after the wall was completed.

The first section of the new wall was started about 50 ft. downstream from the end of the dam apron. The old crib at this point was torn down to river level. The steel caisson was now started, using 14-in., 42-lb. steel piling, driven with a heavy steam hammer. On the tailrace side of the old crib, this piling was driven

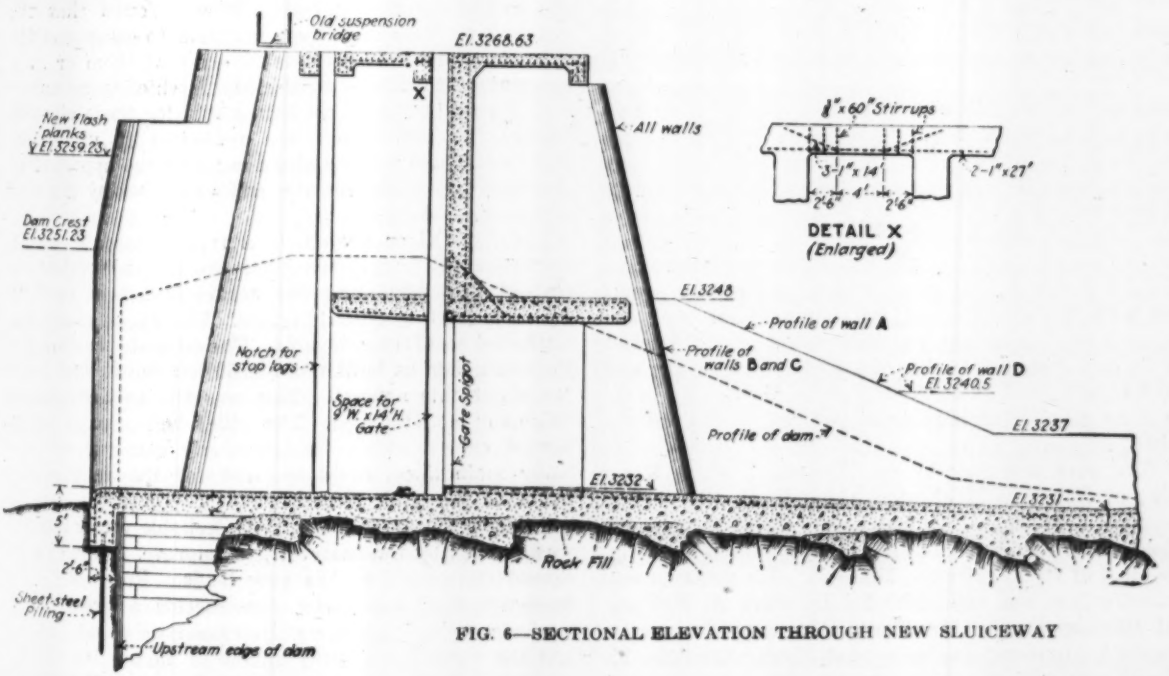


FIG. 6—SECTIONAL ELEVATION THROUGH NEW SLUICEWAY

in the open water outside of the crib. On the river side of the crib and at the two ends of the caisson it was driven through the crib timbers, bolts, rocks and slabs of concrete. Much of the piling had to be withdrawn in a badly battered and twisted condition and repaired, greatly retarding the work. One 10-in. horizontal-shaft and one 6-in. vertical-shaft pump were installed, driven by 75- and 50-hp. motors, respectively. As the driving and excavation proceeded it was found necessary to drive another row of sheetpiling on the river side, outside of the old crib. This added resistance to the water for the time enabled the pumps to keep the water down inside the caisson.

This first section of wall was hardly completed when a flood came down and the gates were opened for a few days. Before the flood subsided it was discovered that the base ledge had been eroded up to and immediately under the new wall section. The gates were closed.

The second (down-river) section of wall was now undertaken. When excavation had reached a point about 10 ft. below water level, leakage under the two courses of caisson steel piling on the river side became so great that the pumping capacity was inadequate, and about 1,000 cu.yd. of gravel was deposited on this side which greatly improved the situation, until the second section was finished.

For the third and longest (up-river) section the progress was slow and tedious, due chiefly to slabs of old concrete 2 to 10 ft. in thickness imbedded in the old crib. It was too close to the power house and dam to permit the use of explosives, consequently "bull points" and picks were used in wearing down the old slabs, which slowed up the work. Little difficulty was experienced with water.

For protection of the base ledge from erosion a concrete mat was laid under water along the base of the wall as a permanent protection. The bedrock was first thoroughly cleaned with a clamshell bucket and a high-pressure water jet. A wall of steel sheetpiling was anchored 20 ft. out from the wall for shutting out all river currents and stilling the water for submerged concrete casting. A wall of sand-filled bags 3 ft. high was laid 15 ft. out from the concrete wall to stop the outward flow of concrete. A mixture of 1½ per cent calcium chloride was used with the cement to hasten its initial set. The concrete was heated to a high degree and a tremie was used for deposition, as the depth of water varied from 18 to 32 ft. Work was commenced at the upstream end so that the laps, if any, would lie with the direction of the water eddies, and was prosecuted vigorously day and night until finished. This mat averaged 5½ ft. thick at the base of the wall and from 3½ to 4 ft. thick 15 ft. out. It was tied to the wall by reinforcing bars previously cast in the wall for this purpose.

The work was done by the Missoula Light & Water Co., of Missoula, Mont., for which C. H. Christensen is general manager. The gates were installed under the field superintendence of H. L. Bickenbach, superintendent of street railways, Missoula. The concrete wall construction was superintended by John A. Hedlund, of Minneapolis, and Mr. Huwe, power station superintendent, rendered valuable assistance through his familiarity with the old structures. The gates and wall were designed by the Power Engineering Co., consulting engineers, Minneapolis, and all construction procedure was carried out under their instructions.

Why Reclamation Costs Differ from Original Estimates

Facts Suppressed in Secretary Work's Comparison of Estimated and Present Costs—Projects Extended on Plea of Land Owners

IN A PARALLEL-COLUMN statement of original estimated cost and construction cost to the present year of the various federal reclamation projects, just issued by Secretary Work of the Department of the Interior, present costs are shown to be far in excess of the original estimate. The statement implies that engineering planning and management of reclamation have been grossly at fault. Inquiries directed to competent authorities indicate that the statement is seriously misleading, and that it suppresses facts which are essential to a proper understanding of the cost figures. The facts as to cost are therefore briefly reviewed here, on the basis of what these authorities have said.

Secretary Work's entire statement is based upon the assumption, which he uses throughout and evidently intends the reader to believe, that the original estimated cost is for the identical structures included in the column of net construction cost. This is not true in the case of any project.

Originally the Reclamation Act was intended to apply to the construction only of such projects and features or parts of projects as were too expensive and difficult for private enterprise. It was assumed and generally promised that the projects benefited by the construction of such large features as reservoirs and main canals would build their own canal systems and distribution systems.

In many instances they already had these systems, and enlargement and extension to adapt them to the new conditions were to be made by the water users themselves. In some cases this was made a specific requirement of the contract. It was found that the water users were unable or unwilling to carry out the extensions and enlargements expected of them or even to acquire title to the canal systems which were necessary for utilization of the water. Under these circumstances the government was requested to undertake large additional work, and did so, with the approval of the Secretary of the Interior and sometimes by his own initiative.

The Salt River project is a typical case in point. In this case Secretary Work lists the original estimated cost at $5,650,000 and the net construction cost to June 30, 1923, as $10,548,119.28. The figure given for estimated cost is questionable. The estimated cost of the Roosevelt dam as built was $3,850,000 and it was built for about this amount. This was the only structure originally contemplated. The valley had a large number of canals which, though poorly constructed and badly maintained, could be used for the delivery of water to the lands already cultivated, and the people were supposed to be able, when a reliable water supply was secured by the reservoir, to improve, enlarge, and extend the canals to the new lands. But while the Roosevelt dam was under construction a great flood washed out the water users' diversion dam 40 mi. below, and the water users being unable to finance its reconstruction, made urgent appeals to Secretary Hitchcock to rebuild it and offered to co-operate in acquiring canals that could use it. Of his own motion, without recommendation from the Reclamation Service, Secre-

tary Hitchcock determined to purchase the canal systems dependent on this dam and rebuild the dam and enlarge and extend the canal systems.

The contract for the reservoir had been drawn in such way as to cover any work the Service might do, and give the Secretary of the Interior the authority to determine the cost, and the water users' association on its part was required to contract to repay to the government such part of the construction cost as the Secretary should assess against its shareholders, thus leaving him in a position to take in some public land and assess a portion of the cost to that and the balance to the private lands which were in the association. This proviso was made the basis of contract on practically all of the early projects, and under it additional work often was taken up, on urgent and persistent pressure from the project people, without a new contract. The various systems of canals in Salt River Valley were purchased for cash and greatly enlarged, improved, and extended to cover new lands.

The original estimate included only the storage works, which were all that were contemplated at the time the project was undertaken. According to the 11th annual report of the Reclamation Service, page 51, these have cost $3,802,897.06, while the other expenses, not included in the original estimate, but built on urgent requests from the water users' association and landowners, amount to 6 or 7 millions and include the following items:

Power system	$2,491,593.04
Granite Reef diversion dam	622,784.04
North side canal system, construction	1,102,005.52
South side canal system, construction	696,541.03
Pumping plants	126,548.64
Real estate purchased	32,028.05
Telephone system, construction and betterments	68,892.49
Roads, construction and maintenance	603,941.03

Yet Secretary Work's statement carries the impression, as it evidently is intended to carry it, that the same works that were estimated to cost $5,650,000 have really cost about double this amount. This is absolutely false.

All the other projects are similarly affected. On two of those projects, the Boise and the Yuma, this identical question has been the subject of protracted and hard-fought litigation, and in both cases the court was convinced that statement of the original cost did not apply to the project that was built because of the great extensions made. For example, on the Boise project, the Arrowrock Dam was not contemplated and never mentioned; in fact, it was not even conceived at the time the contract was entered into with the water users and the canals were built. But it was built as an extension at the urgent request of the water users, who made strenuous efforts to secure the largest reservoir they could induce the government to build. On the Yuma project, the result of the litigation was exactly the same. These two lawsuits occupy such a large portion of the files, in correspondence, briefs, and decisions which were handed down, that it would be impossible for any one examining the files of the Service to overlook them.

The Salt River case and the Uncompahgre case have been so much discussed and the files contain such complete statements that it is equally impossible for the real facts to have been overlooked in these cases. The additional work on the Salt River project was dealt with in the public hearings in 1913, and presented in Congressional hearings at a later date.

In the later years, with the approval of Congress, on a large number of projects drainage works have been carried out which were never contemplated in the original estimates.

As time passed, however, the Reclamation Service learned that those upon the projects desiring to escape their payments were prone to use the same words that Secretary Work has here used to deceive the public by speaking of the original estimates of the "project" and the ultimate cost of the "project" as though they applied to the same works and the identical project, using this argument to prove waste and to discredit the Service and thus escape their payments. Partly for this reason the policy was adopted of requiring a new contract for each additional feature the government was requested to undertake, so that in many cases the additional work is represented by separate, additional contracts. This statement would apply to more than half of the projects. The new work being represented by different contracts, it can not be confused with the works contemplated by the original contract; but Secretary Work's statement does so.

Statements of discrepancies between the estimated and the actual costs widely published by an official as high in responsibility as the Secretary of the Interior (and attributed at least by implication to extravagance, waste, and graft) will encourage those who advocate repudiation of payments. It will tend to diminish the chances of recovery of the cost of the projects.

The Secretary says in his statement on costs: "This intensive study of reclamation as a business is the first ever made. It should have been made ten years ago." The fact is that the Reclamation Service has been under investigation nearly half the time since it began operations, by several Congressional committees, including the Appropriations Committee, and many inspectors from the Secretary's office and from the Treasury Department. In 1910 it was thoroughly investigated by a board of army engineers, which among other things reported that "In its inspection the Board was impressed with the ability of the employees occupying positions of responsibility and desires to record its appreciation of the assistance rendered by them." The most exhaustive examination of all was made by a series of boards of review instituted by Secretary Lane in 1914. Reports by these boards were passed upon by a central board of review consisting of Dr. Elwood Mead of the University of California, Gen. W. L. Marshall, ex-Chief of Engineers, U. S. A., and I. D. O'Donnell, a successful irrigation farmer. Nearly a year was spent in this investigation, and it eliminated two items of cost charged on the books, one from the Salt River project and one from the Uncompahgre project. Yet, in spite of this adjudication, the Secretary asks for authority to reopen all these cases and "make adjustments" between the government and the projects.

Strength of Limestone in Tension

Tension tests on samples of Indiana limestone recently made at the Bureau of Standards, in connection with the design of lifting devices for hoisting large blocks of stone, showed values ranging from 300 to 715 lb. with an average of 535 lb per square inch.

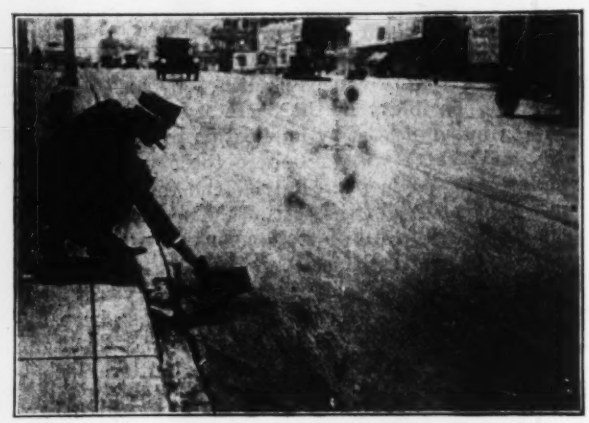
Chicago Heavy-Traffic Street Tests Asphalt Mixtures

Stiff Mixture Stands Up Under Traffic of 16,000 Vehicles a Day While Softer Mixture Ruts and Rolls Badly

By Hugh W. Skidmore
Consulting Engineer, Chicago Paving Laboratory, Chicago, Ill.

TWO distinct mixture designs were employed in street asphalt pavement laid on Michigan Boulevard in Chicago, in 1919 and in 1920. One design failed and the other was a success. As the comparison was unusually fair, these results warrant analysis. Also the conditions represent about the maximum of density of street traffic—that of the famous "link" over the Chicago River and connecting "north" and "south" Michigan Avenue.

Both traffic and foundation conditions are identical over the entire length of this pavement. The traffic is fully as dense as on any pavement in the world. As high as 60,000 vehicles per day pass over the pavement. These are by no means all swift-moving pleasure cars;



TWO TYPES OF FAILURE—RUTS AND WAVES
Note the seriousness of these waves, also the ruts toward the center in the line of travel of light vehicles. The mixture plainly shows its excess of bitumen.

a large number of heavy motor buses ply back and forth night and day. The former tends to roll or wave the pavement transversely, while the latter tend to form longitudinal ruts in the surface. Both of these types of defect are very much in evidence in that portion of this pavement which was laid in the spring and early summer of 1920.

A comparatively small portion of the pavement being considered was laid in the late summer and fall of 1919. The wearing surface mixture was especially designed to overcome any tendency toward distortion under traffic. The mixture was designed for a maximum density, comparatively "dry," i.e., with absolutely no excess of bitumen, and with what was considered by some entirely too much mineral filler. The penetration of the asphalt cement was set as low as was considered entirely safe from the standpoint of cracking, viz., 30 to 35. An analysis of the mixture was as follows:

	Per Cent
Bitumen, by weight	10.6
Mineral passing 200	18.0
Mineral passing 80	26.8
Mineral passing 40	31.7
Mineral passing 10	10.7
Mineral passing 4	2.2
Penetration at 77 deg. F.	33

The maximum amount of bitumen in a large number of samples tested was 10.8 per cent and the minimum was 10.1 per cent; the majority showed about 10.5 per cent. The minimum of filler passing the 200-mesh screen in these samples was 17 per cent while the maximum was 20 per cent; the maximum penetration was 35 and the minimum 31.

No rutting has developed in this portion of the pavement, and the only evidence of any forward displacement occurs to a slight extent at a corner where the heavy motor buses have come to a sudden stop, on a slight down-grade. Even this is as yet of minor consequence and is thoroughly localized. No cracks have occurred, except in one or two instances of surface reproduction of contraction cracks of portland cement concrete base, which appeared during the first winter. It is altogether possible that these also might have been largely overcome by traffic, were it not for the fact that this portion of the work was closed against traffic during the first few months after it was laid. One of the most striking and significant things in this entire stretch of pavement is the joint between the work laid in 1919 and 1920. The softer mixture of 1920 can plainly be seen rolling down over the more stable 1919 work

The character of mixture laid in 1920 is radically different from that of 1919 in two fundamentals; first it carries on the average more than 10 per cent more bitumen by weight, i.e., where the 1919 contained an average of 10.6 per cent, the 1920 mixture showed an average of 11.7 per cent; second, the average penetration of the asphalt cement used in 1920 was over 40, in fact ranged from 36 to 46 with the average at 41. Also the average amount of 200-mesh filler was slightly less than in 1919. All of these things combined to produce a much softer and consequently much less stable mixture than was produced by the 1919 design. The great increase in bitumen content was undoubtedly the principal factor. An average analysis follows:

	Per Cent
Bitumen, by weight	11.7
Mineral passing 200	17.0
Mineral passing 80	27.5
Mineral passing 40	35.2
Mineral passing 10	8.1
Mineral passing 4	0.5
Penetration at 77 deg. F.	41

Numerous samples showed more than 12 per cent and one more than 13 per cent bitumen; and in several samples the content of 200-mesh mineral was 12 to 14 per cent. The variation in these two very important items was much wider than in 1919.

To the careful student of asphalt mixtures, it will be immediately apparent that 12 per cent is entirely too much bitumen for such a severe traffic condition, regardless of the penetration. The low penetration of the asphalt will not cure the tendency to distort under traffic, unless it is accompanied by a proper relation between fine mineral and bitumen. Low penetration in such cases most certainly assists, but it does not alone accomplish the result, in fact it is considerably secondary to the bitumen content in its relation to the filler. During recent extensive repairs to the section laid in 1920, pieces of the original pavement plainly showed an excess of bitumen.

It is not known why the radical departure from the 1919 design was made. Possibly some official may have been unduly alarmed at the foundation cracks which appeared during the winter of 1919-1920, think-

ing the asphalt was too hard. It is now certain that the change which was made spoke failure for the altered type of mixture. It is also of interest to know that this failure was predicted by those who were most instrumental in the design of the 1919 work. Signs of the coming rutting and rolling were evident only a few months after the pavement was completed.

There is no question but that the real predominant cause of the extensive rolling and rutting of the 1920 work is the very decided excess of bitumen in the sheet mixture, assisted by a penetration which was at least 10 points higher than it should have been. Bitumen content of not to exceed 10.5 per cent accompanied by a filler content of from 16 to 22 per cent would have prevented this disturbance. The movement of this pavement has been confined to the sheet top, at least in the beginning, and until waves were sufficient to produce an ever-increasing impact sufficient to distort the binder course as well as the top. During the recent repair work, the old pavement from a number of the badly affected areas was carefully examined and no evidence of binder movement could be noted.

Many large cities have examples of pavement disturbance under dense traffic. The remedy is an easy one, but it must divorce entirely the old ideas of asphalt mixtures that were in vogue before the day of extensive motor traffic. The standard sheet asphalt specifications of the city of Chicago have for many years called for 11 to 13.5 per cent of bitumen, with a maximum of 15 per cent of mineral passing the 200-mesh screen Michigan Avenue is only one of several examples of failures that will continue, unless the standards undergo a very decided change.

Truss Maintains Equilibrium in Load on Footings

Load Carried to New Outside Columns for Wide Opening—Transferred Back to Old Footings by Truss

BY CHARLES CARSWELL
Philadelphia, Pa.

AN UNUSUAL structural problem, involving the removal in the first two stories of the intermediate columns of one bent, and the transfer of the loads the columns had supported through a new system of steel work to the same foundation on which the columns had rested, is a feature of alterations now being completed on the office building formerly known as the Penn Square Building in Philadelphia. These alterations are part of the extensive changes being made in the building including the addition of two stories, the construction of an entire new front, and interior alterations to link up the building with the Finance Building, adjacent to it on the west, of which the altered structure becomes a part.

The Penn Square Building was a twelve-story structure, built in 1900, and first known as the Levy Building. The two new stories are added without any extensive alteration of the old steelwork, a feature made possible by a change in the building requirements of the city of Philadelphia. The old building was designed for a live-load of 100 lb. per square foot, whereas the present requirement as established by the law of 1919 is for 60 lb. per square foot. The possible increase of load under this condition is therefore about 480 lb. per square foot, which would be approximately equivalent to the load requirements for three floors. The present design is based upon a dead-load of 95 lb. and the live-load of 60 lb. per square foot for all floors from the second to the fourteenth; the first floor is designed for 110 lb. dead load and 120-lb. live load per square foot.

The frontage of the building is 36 ft. 1 in., and its framework comprises wall columns and two intermediate

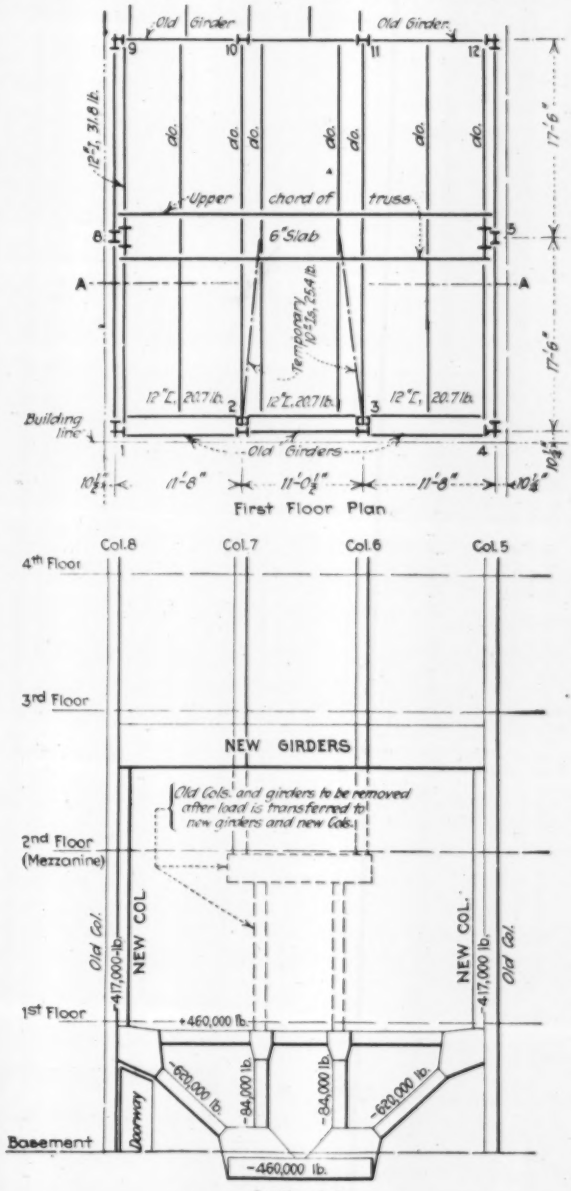


FIG. 1—PART PLAN AND SECTION

rows of columns inside the building, making four columns to each bent. The interior columns are spaced 11 ft. ½ in. apart, and are symmetrical about the center line of the building, except in the second bent. In this particular bent the same arrangement is followed above the second floor level, but in order to secure a better arrangement of store space in the first floor, the two interior columns, in the basement and first tier, were each set 2 ft. nearer the center line of the building, making them 7 ft. ½ in. apart. At the second floor level,

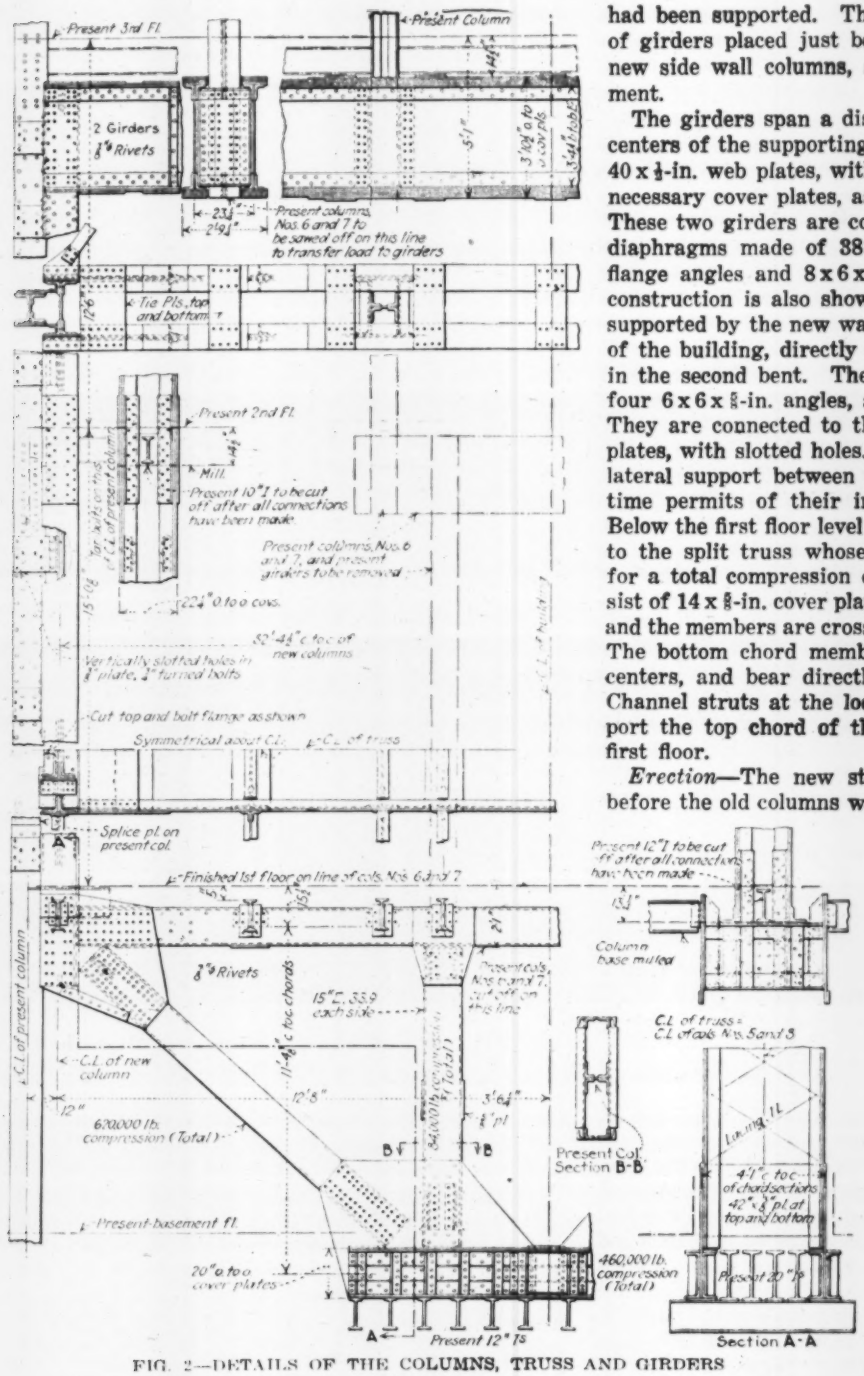

Present 3rd Fl.
Present Column
2 Girders
⅞" Rivets
Present columns Nos. 6 and 7 to be sawed off on this line to transfer load to girders
Tie Pls. top and bottom
Present 2nd Fl.
Mill
Present 10" I to be cut off after all connections have been made
Present columns Nos. 6 and 7, and present girders to be removed
Vertically slotted holes in ⅝" plate, 1" turned bolts
Cut top and bolt flange as shown
Symmetrical about C.L.
C.L. of truss
Splice pl. on present col.
Finished 1st floor on line of cols. Nos. 6 and 7
⅞" Rivets
15" I, 33.9 each side
C.L. of new column
12"
670000 lb. compression (Total)
Present basement fl.
20" to 20" cover plates
460,000 lb. compression (Total)
Present 12" I's
Present 12" I to be cut off after all connections have been made
Column base milled
C.L. of truss = C.L. of cols. Nos. 5 and 8
Present Col. Section B-B
Section A-A

FIG. 2—DETAILS OF THE COLUMNS, TRUSS AND GIRDERS

a girder was connected to the tops of these two columns, and extended out on each side to support the upper tiers at the 11 ft. ½ in. spacing.

In the remodeling it was desired to do away with the second floor in the front portion of the building from the front wall to the third bent of columns. This requirement made necessary the removal of the intermediate columns of the second bent up to the third floor, and for this purpose a system of steelwork was designed to support the columns above that level and to carry the loads to the same foundation on which the columns had been supported. The steelwork consists of a pair of girders placed just below the third floor lever, two new side wall columns, and a split truss in the basement.

The girders span a distance of 32 ft. 4½ in. between centers of the supporting columns, and are composed of 40 x ½-in. web plates, with 6 x 4 x ¾-in. flange angles and necessary cover plates, as noted in the detail of Fig. 2. These two girders are connected to the old columns by diaphragms made of 38 x ½-in. plates with 4 x 4 x ½-in. flange angles and 8 x 6 x ½-in. connection angles. This construction is also shown in Fig. 2. The girders are supported by the new wall columns placed on the inside of the building, directly alongside the old wall columns in the second bent. The columns have 20 x ½-in. webs, four 6 x 6 x ⅝-in. angles, and two 14 x ½-in. cover plates. They are connected to the old columns by ¾-in. batten plates, with slotted holes. This type connection secures lateral support between the columns, and at the same time permits of their independent action as columns. Below the first floor level the new columns are connected to the split truss whose diagonal struts are designed for a total compression of 620,000 lb. They each consist of 14 x ⅝-in. cover plates with two 6 x 6 x ¾-in. angles, and the members are cross-laced with 3 x 3 x ⅝-in. angles. The bottom chord members are spaced 4 ft. 1 in. on centers, and bear directly on the old column grillage. Channel struts at the location of the old columns support the top chord of the truss and the loads of the first floor.

Erection—The new steelwork was erected complete before the old columns were removed. The truss in the basement was erected first, and the new side wall columns were then erected on it and connected to the old columns. The diaphragms for connecting the columns to the girders at the third floor, were next riveted in place on the old columns. The two girders were brought in on the second floor of the building through the windows and riveted to the diaphragms and to the new side wall columns. These connections made the new steelwork complete, ready to support the column loads. The old columns were sawed off at the bottom of the new girders, sawing being used instead of burning in order to transfer the load gradually.

When the supporting steelwork was in place, the floor beams of the second floor were removed. Removal of these beams made too great an unsupported length in the intermediate columns of the front wall so they were each reinforced by a new section composed of two channels extending from above the first floor to the bottom of the third floor steel, and placed on the inside of the old columns and riveted by ⅞-in. batten plates.

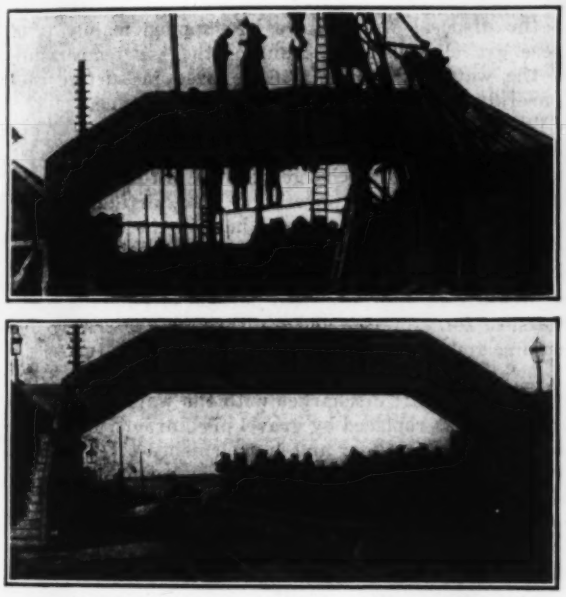
The building is owned by the Finance Company of Pennsylvania. The architects are the Hoffman-Henon Co. of Philadelphia, and Percival M. Sax is engineer.

From Job and Office

Hints That Cut Cost and Time For the Contractor and the Engineer

Precast Concrete Units Used for English Footbridge

IN THE recent rebuilding of a footbridge over the tracks at a country station of the Southern Ry., England, a novel design consisting of precast concrete units was adopted. This is shown in the accompanying view. The two 38½-ft. girders have their 7½-ft. end panels inclined downward to carry stairways, and the girders are seated on four-post braced towers, the tops of which form landings for stairways parallel with the tracks. Floor beams fit into sockets on the



FOOTBRIDGE BUILT OF CONCRETE UNITS
Above: Locomotive crane erecting one of the 38½-ft. girders. Below: completed structure.

bottom chords of the girders and upon these are laid the floor slabs. The lower stairway girders rest on the towers and the stairs rest on the lower chords of these girders. The units were made at Exeter, where the railway has a yard for the manufacture of various concrete articles. All the girders were cast on their sides. The units were erected by a locomotive crane.

Demolition of the old wooden bridge was commenced at midnight on a Saturday and completed by 6 a.m. next morning. The erection of the towers, girders, stairs and other parts was interrupted occasionally by the necessity of clearing the tracks for trains, but the entire work was completed by 7 p.m., except for the grouting of some connections. The cost is said to be less than that for a steel structure, even including the forms, which will be used for similar bridges.

The designs were prepared under the direction of A. W. Szlumper, chief engineer, and the structure is described in the *Railway Gazette*, London, by W. H. Shortt, district engineer.

Sightly Construction Gallery Protects Sidewalk in Chicago

THE UNUSUALLY elaborate sidewalk gallery shown in the accompanying view is not a permanent arcade but is erected simply for the convenience and protection of the public during the construction of the 32-story

FIG. 1—SIDEWALK GALLERY AT STRAUS BUILDING, CHICAGO

Straus Building at Jackson St. and Michigan Ave., Chicago. Since it was felt by S. W. Straus & Co., the owners of the building, that the usual rough timber gallery or shelter would not be in harmony with the building or its surroundings, the architects were instructed to provide a sufficiently artistic structure and the design was submitted to the South Park Commissioners for consideration. Arches and ornamental railings are placed in the openings between the posts which support the working deck over the sidewalk, and an

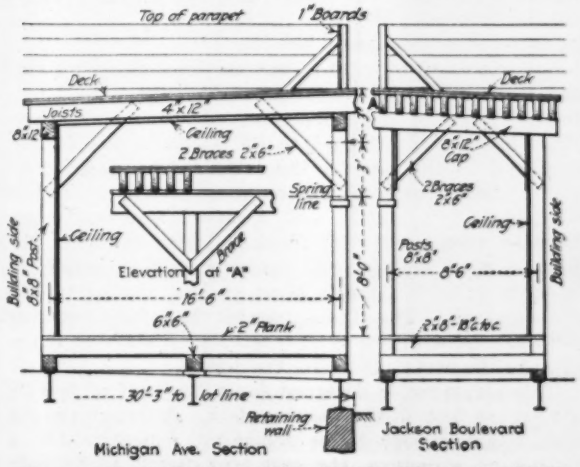


FIG. 2—STRUCTURAL DESIGN OF SIDEWALK GALLERY

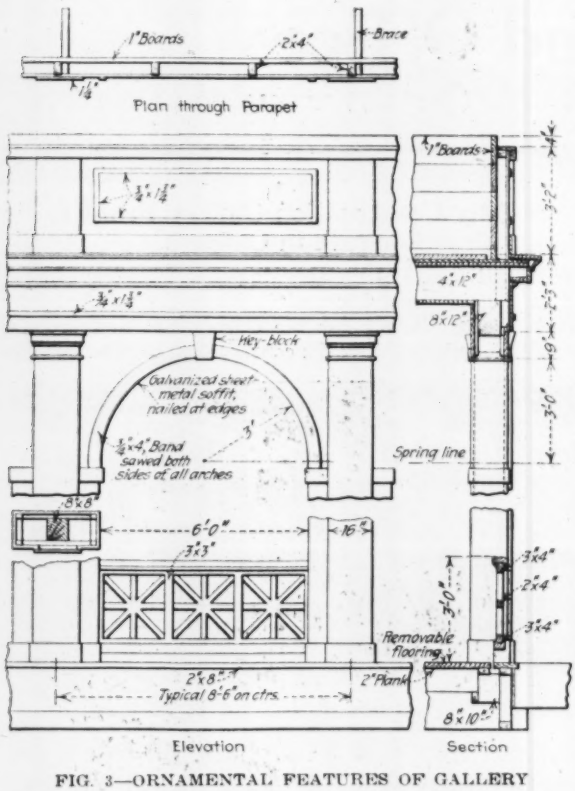


FIG. 3—ORNAMENTAL FEATURES OF GALLERY

ornamental parapet surrounds this deck. The structure is painted in two shades of light buff or stone color, and on each street face there is a large panel with a reproduction of the architect's design for the completed building. At first the floor was above the sidewalk level and was reached by two steps, but this floor was removed after completion of the permanent sidewalk.

In its structural design, shown in Figs. 2 and 3, the gallery consists of two rows of 8x8-in. posts spaced 8½ ft. c. to c. on the Jackson St. side and 16½ ft. for the wider Michigan Ave. sidewalk. Longitudinally the spacing is about 8½ ft. c. to c., with archway openings of 6 ft. clear width, but at the corner and at the contractor's driveway entrances the clear width is 15 ft. On the Michigan Ave. side the posts carry two lines of 8x12-in. stringers on which are transverse 4x12-in. joists spaced 10 in. c. to c., but on the Jackson St. side the posts carry 8x12-in. transverse caps with longitudinal joists of the same size and spacing as above. Knee braces are attached to the joists in the former case and to the caps in the latter. The deck which slopes down towards the building, consists of two courses of ¾-in. boards with a layer of roofing paper between them and 2-in. plank battens on top. The posts rest on 8x10-in. sills carrying 2x10-in. joists, 18 in. c. to c., with a single layer of 2-in. plank to form the sidewalk. The 42-in. parapet has four rows of 1-in. boards, with braces at intervals. Sheathing is applied to the posts and under the joists.

This structure is designed for a live-load of 500 lb. per square foot on the working deck. Although the design might appear to be somewhat expensive for a temporary structure, the cost was found to be only slightly greater than that for an ordinary rough and unpainted shelter or gallery. The general contractor is the Thompson-Starrett Co., and the architects are Graham, Anderson, Probst & White, Chicago.

From Job and Office

Hints that Cut Cost and Time

Device Removes Sand from Gravel Wells

By C. K. Calvert
Assistant Sanitary Engineer, Sewage Disposal Plant, Indianapolis, Ind.

IN FINISHING wells which will supply water for the new sewage disposal plant at Indianapolis the old air-lift idea to clear them of sand was used but the operators became disgusted with the hand-operated discharge valve and a home-made automatic control was devised. Condenser water for the main power plant of the disposal works is to be supplied mainly from these gravel wells on account of the low temperature of the water. Since it will be used in surface condensers, it must be reasonably free from sand.

The sand is removed by air-lift as follows: When the pump pit excavation is completed, an air-lift is installed with its discharge passing through a special flange which makes the casing head airtight so that pressure may be built up and held in the casing. Air is delivered to the ejector head continuously. Manipulation of a valve on the discharge line causes periods of pressure to alternate with periods of pumping. The pressure forces water and air through the screen, dislodging and agitating the sand and gravel, and on release the water rushes back into the casing, carrying sand which the air-lift discharges with the water. The sand so removed is replaced by gravel piled around the casing on the excavation floor and is replenished after settling.

Extensive tests determined the optimum duration of pressure and pumping periods. Operation of the ordinary gate valve on the air-lift discharge line is time consuming, and a quick-opening valve was substituted. As hand operation was erratic and not dependable, the

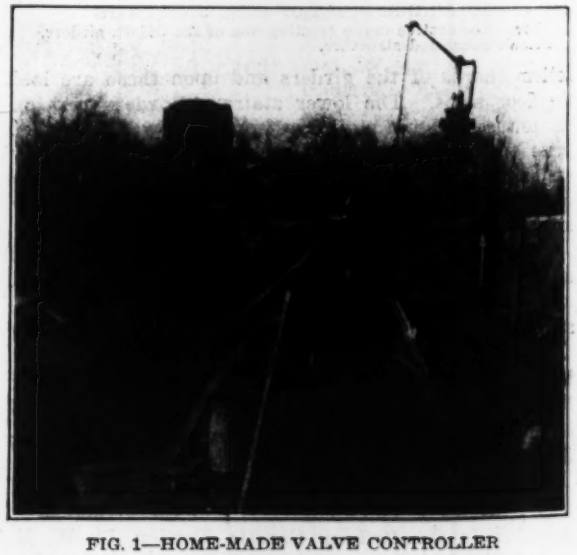


FIG. 1—HOME-MADE VALVE CONTROLLER
Bucket on right end of lever arm up and receiving a portion of water from sand tank.

From Job and Office

For Contractor and Engineer

automatic valve control shown in the illustration was devised to reduce the time of sand pumping and eliminate the cost of an operator.

On starting the air-lift, the mechanism is in the position shown in Fig. 1, the counterweight on the left of the arm is down. This holds the water bucket on the right up and in position to receive water from the sand tank overflow. The rod on the right end of the arm holds the air-lift discharge valve open.

Water now flows through the sand-tank overflow line, a controlled part of it going to the water bucket. When the counterweight is overbalanced, the water bucket falls, clearing the stream of water which filled it, and closing the air-lift discharge valve. During this period the water and air rush out of the casing through the screen and disturb the sand and gravel. This position, shown in Fig. 2, is maintained until the water in the bucket runs out through a bottom valve. In this position the air pressure is released, the water, carrying the fine sand, rushes back through the screen into the casing and is raised to the sand tank by the air-lift. The operations are repeated as long as air is supplied to the air-lift.

By manipulation of the valve into and out of the water bucket, the time of filling and emptying, and consequently the period of pumping and pressure on the well, may be varied widely. When adjusted to any rate, the operation is constant and needs little attention.

The sand tank is baffled and provided with a cone bottom which facilitates sand removal. It is usually removed and measured once in 24 hours.

The installation has proved satisfactory. It clears the well of sand in the shortest possible time and gives an opportunity to observe the rate of sand removal and its total volume.

FIG. 2—SECOND POSITION OF VALVE CONTROLLER

Bucket full descends and angle coupling diverts discharge away from bucket. Rate of flow from pipe in side of bucket near bottom determines the interval before light-colored bucket (left) and counterweight lifts empty bucket and opens valve.

How Dynamite Is Used in Ice Blasting

By N. D. Rand

Technical Division, Atlas Powder Co.

DURING THE winter months ice forms so quickly that at times shipping is bottled up. To relieve icebound boats a channel must be opened and the most practical and quickest way, as well as the least expensive, is to blast the channel out with explosives.

There are two methods of opening up a channel: (1) by placing light charges along the edge of the ice the width of the desired channel and (2) by placing charges along the center line of the channel. The former will break the ice into small cakes, and the latter must contain charges heavy enough to break the ice the entire width of the channel. An experiment in both methods will determine which is the better for the particular conditions encountered.

In order to open a channel holes should be cut through the ice with an ice spud, a splicer bar, or a crowbar. These holes should be from 6 in. to 1 ft. in diameter and cut through the ice to the water beneath.

A good blast does not throw ice and water high up into the air. If that happens, the next charge should either be decreased or lowered further into the water. Distance apart at which to place holes can be determined from the area broken, though the usual distance is from 15 to 25 ft. If there is a current sufficient to carry out the ice charges may be so placed as to break the ice into large cakes. Where no appreciable current exists, ice must be broken into small sizes.

In preparing a charge a rule-of-thumb method which will be successful calls for the use of three times as many cartridges as the thickness of the ice is in feet, and a depth below the ice of one-twelfth of the diameter of the area to be broken. The required number of cartridges should be tied together after having primed one with a waterproof electric blasting cap and smeared a waterproofing compound over the hole where the cap enters the cartridge in order to exclude water from the powder. The cord used to tie the cartridges together should have a free end long enough to lower the charge to the required depth. To hold the charge at the proper depth, tie the free end of the cord to a stick of wood placed across the top of the hole. Dependence should not be placed upon electric blasting cap wires to hold the charge in place. The following table indicates the quantity of explosive to be used and the depth under the ice at which it should be placed for best results in ice of varying thicknesses:

TABLE OF CHARGES

Thickness of Ice in Feet	Number of Cartridges of 40% Gelatin Dynamite	Depth Below Ice in Feet	Diameter of Area Broken in Feet
½	1	1½	20
1	3	2	25
1½	4	3	35
2	6	4	50
3	10	5	60
4	20	6	70

Charges should be fired electrically as it enables several charges to be fired at the same time, the combined force of which will break up more ice than if each charge is fired independently.

Large cakes of floating ice may be broken by laying a large charge of dynamite on top of the cake and priming with cap and fuse. The amount of the charge may be determined after a few trials, starting with one or two cartridges. The following table shows the approximate number of 1¼x8-in. cartridges of 40 per

cent strength necessary to break cakes of varying thicknesses:

Thickness of Ice in Feet	Number of Cartridges
½	1
1	2
1½	4
2	6
2½	8
3	10

If it is impossible or unsafe to get on the large cake of ice in order to place the explosive, the dynamite may be tied to a stone or stick of wood, the fuse lighted and the charge thrown upon the cake of ice in such a manner that it will land as near the center as possible. Such charges are primed with cap and fuse, the fuse being lighted just before dropping the explosive to the ice, and of a length sufficient to permit the cake of ice to float away before the charge detonates. Safety fuse burns at an approximate rate of 2 ft. per minute. Therefore, it should be cut to a length corresponding to time it is desired to fire the charge after lighting.

Another use to which dynamite may be put is in breaking up ice jams at bridge abutments or narrowed river channels, etc. Under such circumstances timely action may prevent considerable damage to construction work. The size of charge is dependent upon the thickness of the ice piled up. In this class of work it is advisable to use a blasting machine and electric blasting caps because of their greater safety. If the ice has piled between piers of a bridge the explosive charges should be placed in the ice midway between piers and all charges fired simultaneously with a blasting machine. Place the charge as near the front of the jam as possible, because there is where the cakes have become locked. If the ice does not break at the first charge successive heavier ones should be used until it starts to move. Where gorges have formed to a considerable thickness making it difficult to dig a hole through the ice with the tools at hand, a small hole can be cut into the ice as far as possible and one or more cartridges exploded to cut the hole deeper. This operation can be continued until a hole is cut either through the ice or to the desired depth.

To prevent the formation of a gorge where it is liable to appear every year at the same point, begin at a short distance downstream and honeycomb the ice all the way upstream by successive charges. When the thaw comes the broken ice will go out in a body with less likelihood of jamming.

Explosives have also been used on occasions to cut through deep snow drifts and to start snow slides on hillsides.

The proper explosive to use for ice blasting when the charge is placed beneath the ice is a low-freezing, strong, fairly quick acting explosive not readily affected by water. Low-freezing extra dynamite and low-freezing gelatin dynamite are well adapted for the purpose. If the charge is placed on top of an ice floe, a quick-acting explosive should be used, either low-freezing straight nitroglycerin dynamite or non-freezing dynamite of 50 per cent strength or sometimes stronger. Unless a non-freezing explosive is used, particular care should be exercised to see that the dynamite is not frozen. A low-freezing dynamite will not freeze during the short time that it is in the water, but if it is previously frozen it must be thawed before being used.

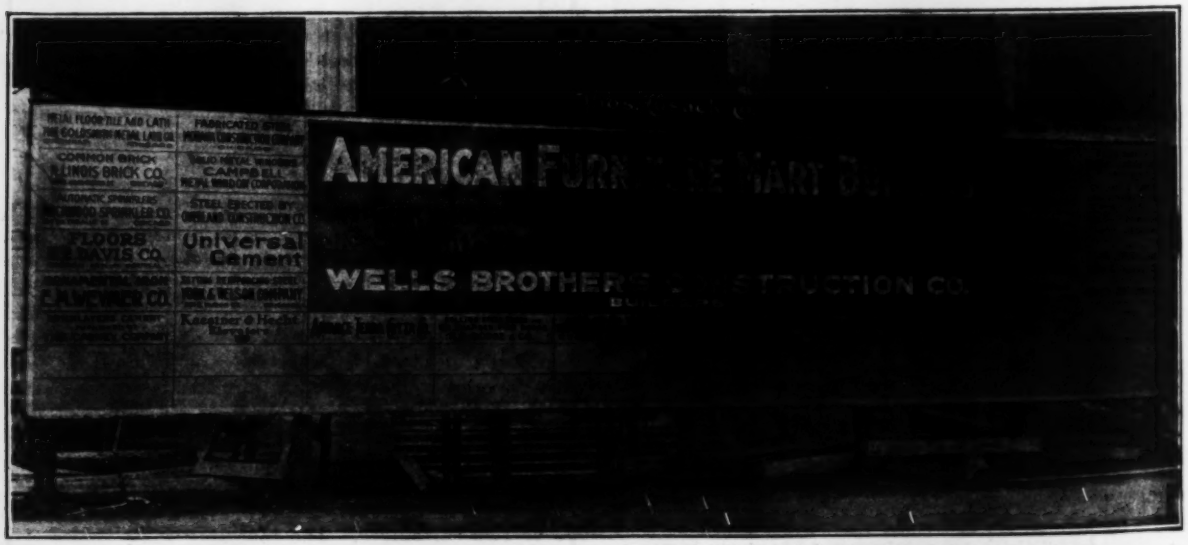
The materials for ice blasting can most conveniently be carried over the ice in a box fastened to a sled. Full instructions for priming a charge, either by the cap and fuse method or by the electric blasting cap method, may be obtained from literature published by any explosive manufacturer.

From Job and Office

Hints that Cut Cost and Time

Contractor's Sign at Large Building

ON EXTENSIVE construction works, especially on building erection, it is becoming general practice to display large signboards bearing the names of contractors and sub-contractors. In this way adequate publicity is given, while the unsightly appearance of numerous individual signs of various sizes and styles is avoided. A combination sign of this kind, erected by the Wells Brothers Construction Co. at the new Fur-



SIGN ON CHICAGO STRUCTURE DURING ERECTION LISTS ARCHITECTS AND CONTRACTORS

From Job and Office

For Contractor and Engineer

niture Mart Building, Chicago, is shown in the accompanying view. It is about 8x30 ft., built up of sheet-metal panels. As a rule, these signs are made and placed by the contractor, but in the case of the Furniture Mart a sign company made an offer to the contractor to erect a satisfactory electrically-lighted sign and as the price was considered favorable this offer was accepted.

In arranging for this sign, the contractors knew that not all of the sub-contractors wished to have their names posted, but on the basis of the expected number the cost was divided between architect, contractors and sub-contractors on a pro-rata basis according to the space used. One form letter was addressed to all sub-contractors telling about the proposed sign and asking them to forward copy if they desired to participate. No further solicitation was used. It is believed that this plan accomplished the desired end satisfactorily, with less trouble to the contractors and no greater expense to any of the participants than if the sign had been made in the usual way. Any method which requires or compels sub-contractors to take space is evidently undesirable. The cost of a large sign is no small item and logically it should be paid for by those who desire to benefit from it.

Construction of a 9-ft. Pipe Line Six Miles Long

THE OAK GROVE hydro-electric project of the Portland Railway Light & Power Co., now under construction on the Clackamas River in Oregon, has a 9-ft. pipe line six miles long. This line will supply the first of three 35,000-hp. generating units which will operate under an effective head of 860 ft., the static head being 925 ft. When the other units are added a second pipe line 11.5 ft. in diameter will be laid paralleling the one now being built. Work on the project is advancing rapidly and the pipe line is expected to be completed by February, 1924, about two months before the plant is scheduled to go into service. A note on the general features of this development appeared in *Engineering News-Record*, Aug. 2, 1923, p. 197.

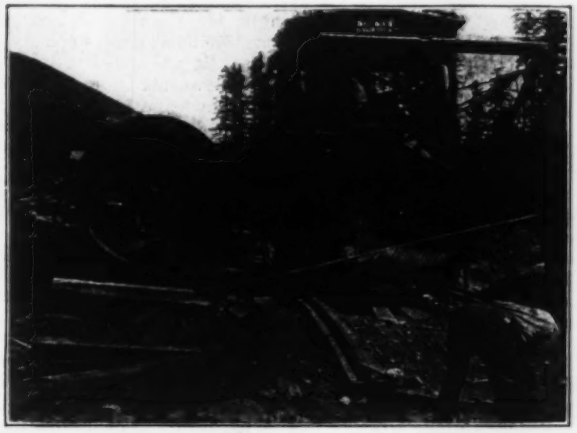
The distance between intake gates and turbine is 36,334 ft. traversed as follows: 32,900 ft. of 9-ft. steel pipe, which is kept below a controlling hydraulic grade of 2 ft. per 1,000; 2,150 ft. of concrete-lined tunnel, and 1,300 ft. of penstock down a steep incline, the pipe diameter here varying from 8 ft. at the top to 6 ft. at the bottom.

The steel plate for the pipe, varying from $\frac{3}{8}$ to $1\frac{1}{8}$ in. in thickness, was produced at Sparrow Point, Md. and delivered by water to Portland where it was formed into pipe sections 40 ft. long. These sections, weighing about 9 tons each, are transported on flat cars to unloading stations established on the construction railroad at convenient points along the pipe-line grade. Most of these unloading stations are at higher level than the pipe grade and sections are snubbed to the grade on skids with the aid of a cable. On all plate thicknesses of $\frac{3}{4}$ in. or less the pipe is reinforced by outside stiffener rings made of 5x3x$\frac{3}{8}$-in. angles spaced 2 ft. 9 in. apart. These angles have been of material assistance in making the pipe rigid for handling.

Laying the Pipe—In the construction program as planned at first, overhead cableways were to be used for moving the sections along the grade from unloading station to final destination. This plan was abandoned in favor of a gantry traveler that would straddle the pipe line and move sections along the grade as required.

The device built for this purpose and shown in the accompanying picture is a structural steel frame mounted on wheels set for track of 11 ft. 8-in. gage. It has a wheel base of 16 ft. and is 12 ft. 8 in. high. The operator's station is on the "upper deck" where the motor, cable drums, etc. are located. Power is supplied by a 50-hp. gasoline motor taken from a 5-ton truck and this is geared down so that a maximum speed of about 250 ft. per minute is made along the track.

When a pipe section arrives on the grade it is rolled between the gantry rails; the gantry moves over it and the section is picked up by cable slings from drums



GANTRY CRANE PICKING UP 40-FT. SECTION OF PIPE

directly overhead. To facilitate rapid handling of the pipe without danger of damage, pieces of old automobile tire casings are fastened to the wood stops over the pipe-way in the traveler to serve as cushions. On delivery the gantry does no exact setting in place, but leaves the section in its approximate position on the grade.

The riveting gang uses a traveler similar to the one already described except that power is supplied by a 7x10-in. steam donkey mounted on top of the steel frame. With this traveler the pipe section is lifted by slings from a boom that can adjust the position of the section as may be required.

With this plan of operation, as many as 16 pipe sections have been placed in 8 hours. The traveler crew consists of five men in addition to which are the crew that snubs sections down from the railroad and the gang that picks up and re-lays track. Track is moved ahead by the gantry and is set by use of the two booms shown in the picture. The rails, in 20-ft. pieces, are spiked to 8x16-in. timbers of the same length, no cross-ties being used.

The pipe distribution is being done by the Hurley-Mason Co., of Portland, who are the general contractors on the project. The J. G. White Engineering Corp., New York, are the consulting engineers. H. A. Rands is construction engineer for the Portland Railway Light & Power Co.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Should Concrete Swimming Pools Be Emptied in Winter?

Sir—In replying to the question, "Should Concrete Swimming Pools Be Emptied in Winter?" asked by Adams & Ruxton Construction Co., in *Engineering News-Record*, Nov. 22, p. 858, the editor advised that, so far as his experience went, such pools were always emptied. While the usual custom is to empty concrete pools, we do not believe it is necessary to do so, and in fact we know of three such pools, located in cold climates, that are not emptied and no trouble has resulted.

If concrete pools are allowed to stand empty and without protection throughout the winter, we suppose that it is done to protect the walls from the horizontal pressures which a sheet of ice on the surface is presumed to exert. We say "presumed to exert" as there seems to be little or no conclusive evidence or positive knowledge as to whether such pressures actually develop in comparatively large bodies of still water contained in rigid walls, and if so, how much pressure actually develops.

As suggested by Adams and Ruxton, we are inclined to believe that a penetration of frost through an unprotected concrete floor slab into a more or less saturated subgrade to a depth of 4 ft. or more would be likely to cause some displacement of the slab with a possible injury to it.

The vertical walls of a pool are designed to resist the normal pressures of the soil when the pool is empty, but they are not designed to resist pressures of frozen earth as the knowledge of such pressures is inadequate for accurate design. A discussion of the formation of ice may shed some light on this interesting problem.

When freezing weather comes, ice forms first around the edges of the pool and as the sheet of ice builds out toward the middle, the thickness at the edge increases. Finally a closure is formed at the middle of the pool and the sheet of ice increases in thickness by building downward. Each additional inch of ice formed on the bottom of the ice sheet displaces approximately 0.1 in. of water. The displaced water finds relief through the path of least resistance which in this case is upward through the sheet of ice, causing it to bulge up slightly at the middle. Thus, if ice were formed with a uniform thickness of 10 in., it would be bulged up into a slight dome shape by approximately 1 in. of displaced water over the surface of the pool. The maximum horizontal pressures against the sides of the pool will be limited by the strength of the slab of ice in resisting the uniform load imposed by the upward pressure of the water. Now if the pool has a minimum width of 25 ft. and the ice a thickness of 12 in. the sheet of ice may be considered as an unreinforced flat slab 12 in. thick with a 25-ft. span uniformly loaded by the upward pressure of the water. If we assume that ice has a tensile strength of 150 lb. per square inch, a slab 12 in. thick having a span of 25 ft. would resist pressure of only 46 lb. per square foot. The increased pressure against the sides of the pool would be approximately equal to that of an additional 9-in. depth of water.

In view of the above considerations, we believe that there is less probability of injury to a well designed pool having minimum dimensions of 20 ft. or more where it is left filled with water to a depth of 1 ft. below the normal level than where it is completely drained for the winter.

A pool at Garden City, Kan., 218 x 345 ft. in plan, with three sloping walls and one vertical, has been allowed to freeze with no apparent damage. A rectangular pool at Abilene, Kan., 60 x 120 ft., with four vertical walls, has been allowed to freeze every winter since 1914 without damage. Some winters the ice was more than 18 in. thick on this pool. A 63 x 155-ft. rectangular pool with all walls vertical, at York, Neb., has been allowed to freeze several times without injury.

Experience and observations of other engineers and managers of pools would add to the knowledge on this subject. Most assuredly, if it is possible to utilize concrete swimming pools as winter skating rinks, such use should be made of them, thereby adding several months per year to the period of their utility.

C. D. HALE,
Civil Engineer.

Chicago, Ill.,
Dec. 4, 1923.

Shoddy Building Work Briefly Reviewed

Sir—I have just read in the morning's paper of the dismissal of three of the four indictments which grew out of the collapse of the American Theater building in Brooklyn on Nov. 29, 1921, and am prompted to suggest that this item of news affords an opportune occasion for your paper to review the conditions which preceded and surrounded this conspicuous illustration of the ineffectiveness of existing methods of controlling building operations, in the interest of elementary public safety right here in Greater New York.

The following quotations from statements published in the Brooklyn *Eagle*, reporting actual court testimony, ought to prove illuminating in this connection and help to keep alive an interest in all efforts made to improve the underlying conditions responsible for this disaster.

The architect is quoted as testifying that he had employed a relative of the Superintendent of Buildings "to draw up the plans for the steelwork and facilitate the passing of the plans by the Building Department." He is also quoted as testifying that these first steel plans were not used in construction, but that plans made by the steel contractor were later substituted. The architect's connection with the work, however, apparently ended with the furnishing of plans.

The plan examiner in the Department of Buildings is quoted as testifying that he had made 21 objections to the plans submitted by the steel contractor, and that the changed plans were not finally approved until Nov. 2, 1921, a date about two weeks later than the date sworn to by the steel erector as that on which he completed his work. In other words, the steelwork had been erected about two weeks at the time the steel plans were approved.

The steel erector is quoted as saying that he had no working plans, but erected the work "just by putting things where they seemed to fit," and after being shown the approved plans said they were not followed in the work.

The same erector is reported as testifying that he knew the main column was not plumb, that the base plate was too small and that he had forced wedges under it "to take up the slack," and, further, that an excavation was made alongside the column footing and where jacks were used to force the column into an upright position.

The Superintendent of Buildings is reported to have said, "No permit had been issued and I did not know that the building was in course of construction until I received news of the collapse."

The iron inspector of the Department of Buildings is quoted as saying, "I don't think there is an exception in the whole borough where the theater has not been allowed to go ahead before the steelwork has been approved."

Much more of the same sort could be quoted, but the whole situation is well summed up in the memorandum filed by the presiding judge as follows: "There was no architect in charge of the work. There was no competent supervisor. There was no responsible engineer. There was no approved plan for the steelwork. There was no official permit allowing its erection." In spite of all this it has proved impossible to fix responsibility for the loss of life, and the incident will probably be forgotten until the next similar disaster recalls it to attention.

J. B. FRENCH,
Consulting Engineer.

New York, Dec. 7, 1923.

Bending Action in Bascule Bridge Counterweight Failures

Sir—Your article of Nov. 29, p. 872, on two accidents to bascule bridge counterweights attributes these failures to the excessive distortion developed in the members of the steel frame of the walking-beam. The distortional or so-called secondary stresses in the members of this frame are undoubtedly very high, but it seems equally probable that the cause of these failures may be due to the design of the truss members embedded in the concrete counterweight.

This trussing is relied on to pick up all the weight of the concrete by its adhesion to the steel which is embedded in the concrete. The members of this trussing are only designed to take direct stress, and therefore all the adhesion must take place at the panel points or in a plane parallel with the members, if bending in them is to be avoided. The former is of course impossible without developing infinitely high adhesive or bearing unit stresses, and it seems very doubtful if the latter condition can be fulfilled for all the positions of the counterweight. The stiffening effect of the concrete on the embedded members, to enable them to take cross-bending, cannot be effective if the steel is not capable of taking shear in itself, which is the condition here.

Should excessive bending be developed in the embedded members of the counterweight trusses adjacent to their connection to the walking-beam frame, they in turn must exert a moment in the connection, which would produce a tearing action on the chords of the walking-beam and cause them to break at the same point where they would be most severely strained by distortional strains of the walking-beam trussing itself.

Another point to consider is the excessively high range of unit stress in the embedded trussing. It seems questionable whether concrete can permanently adhere to steel that has a frequent strain range of 20,000 to 30,000 lb. per square inch.

The nature of the break at the Lachine bridge would seem to indicate a progressive failure of the bond between the concrete and steel near the point where the trusses deliver their loads to the walking-beam frame. The bond between the concrete and steel being a maximum at the outer edge may have broken down and the fracture continued to spread every time the bridge was operated and the stresses reversed, until this part of the steel frame which had lost the stiffening effect of the concrete was overstressed and failed. The adjoining views show the break in the embedded truss connection which first gave way. It will be seen that the break occurred at the point in the member where it is weakest to resist local cross-bending.

Taking off the side plates on the two bridges should not have weakened the structure, as the bolts passing through these plates and the concrete were not designed or constructed to take any shear, and the value of any adhesion between these plates and the concrete could not be relied on. It was generally thought at the time of the first accident that, if the plates did partly support the counterweight, the eccentric position of the plates was a real danger to the structures and may have contributed to the cause of the break in the chord.

The correct analyzing of the stresses in the counterweight trussing is a most confusing and complicated problem, and until it is clearly understood the causes responsible for these failures cannot be decided.

BRIDGE ENGINEER.

Dec. 4, 1923.

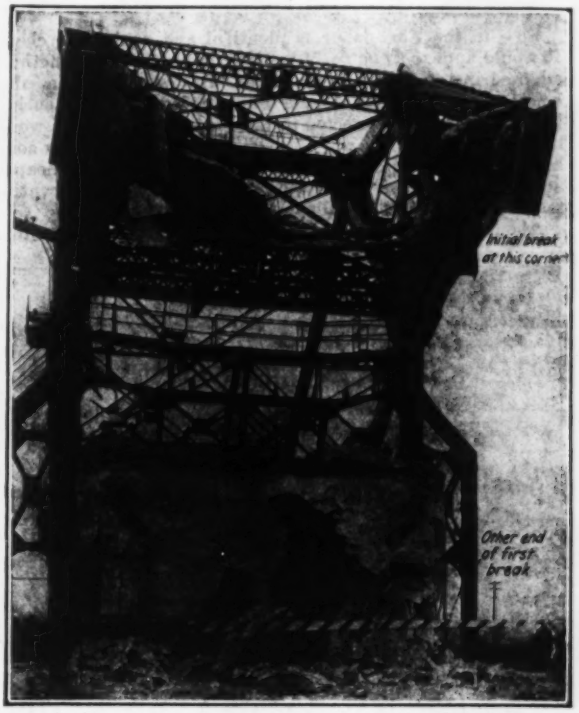
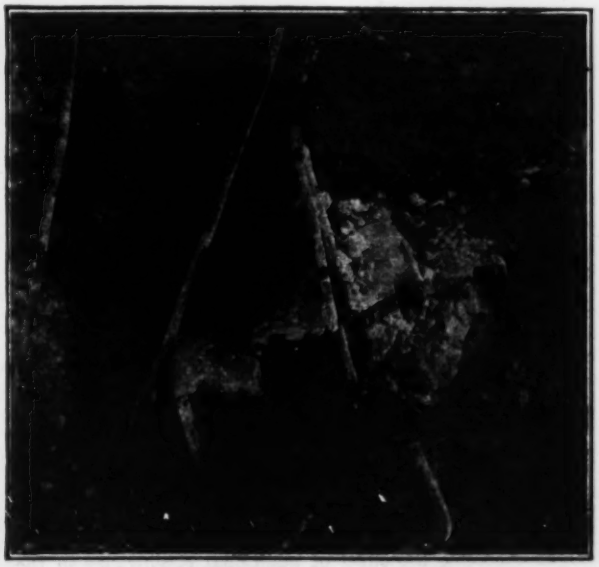


FIG. 1—LACHINE CANAL BASCULE SEEN FROM BACK OF COUNTERWEIGHT AFTER FAILURE

Rear edge of counterweight lies on ground, front end is at top. Right hand side was place of initial failure.

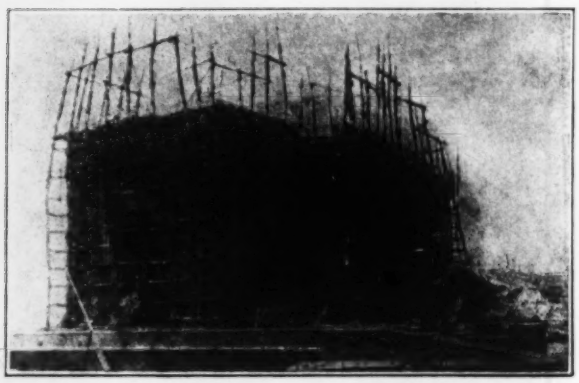


FIGS. 2 AND 3—CLOSE-UP VIEWS OF INITIAL BREAK AT TRUSS AND COUNTERWEIGHT ENDS

Construction Methods in India

Sir—In the East labor is plentiful and said to be cheap. It would appear to be so, if we may judge from the methods adopted in the construction of the "Gateway of India" now being erected on the Apollo Bunder, Bombay. If such a building were being erected in the West, a large crane would have been placed in a suitable position, and worked by some kind of power. But in India, no! Man-power is cheaper, and the contractors follow the primitive method of elevating material by means of pulleys and ropes.

About twenty men hold the rope, and pull up the stone



BUILDING THE "GATEWAY OF INDIA"

a short distance, chanting a kind of sing-song all the time. There are several men stationed on the bamboo scaffolding to direct the course of the stone as it steadily rises to the top of the building. It seems curious that modern methods of hauling should not more quickly be adopted in India.

Hassan, India, "AJAX."
Oct. 2, 1923.

Providing for Secondary Stresses

Sir—Your editorial of Nov. 29, p. 872, in regard to the danger of failure from secondary stresses, seems to me to be very timely and likely to be very useful. American structural practice in the last 25 years has developed more and more the use of large riveted joints instead of the pin joints used in earlier designs. Probably this tendency has been due partly to the pneumatic hammer, which drives a good field rivet so cheaply. Partly also it has been due to the great increase in stiffness secured by using rivets instead of pins for joint connectors.

We have all known that in some way the structure pays for that increase of stiffness. But there are two considerations which offset a loss of ultimate strength due to secondary stresses in a bridge truss: (1) Impact or vibration is reduced by the increased stiffness, and girder action reduces the stresses from truss action. The total direct stress on the members is thus relieved. (2) The induced secondary stresses before causing failure tend to relieve themselves by permanent bends in the members. The second consideration taken at its face value would seem to indicate that no member could pass the elastic limit from direct and secondary stress alone.

There is a third consideration however, that should make us fearful of the repetitive effect of strong secondary stresses on compression members. Suppose that under a severe loading the given member has such bending from secondary stress that some fibers pass the elastic limit. The member will then take a permanent bend. Under the next application of the same loading the stress from secondary action will not be so large as before, but there will be an increase of eccentricity in the member which might cause the stress in the same extreme fibers again to pass the elastic limit, and cause a further bending. Relief of secondary stress by the bending of heavy tension members might overcome the effect of additional eccentricity in the compression members, but we should not cheat ourselves into security by maintaining that secondary stresses can never cause failure.

It seems very clear that the exact computation of secondary stresses in minor structures cannot be undertaken or recommended. We have progressed to the point of regarding them in large structures, and even of attempting to remove by initial bending those caused by dead-load. We might, by introducing initial eccentricities in the large compression members, perhaps halve the secondaries from dead-load. In minor frames, if the designer understands secondary stresses and keeps them in mind in laying out his structure and in designing its members, he can keep their effects to a minimum without going through long and tedious calculation. He should make the compression members as shallow in the plane of the truss as other design considerations will permit. He should make gusset plates as small as possible.

Many of us cannot help feeling that a wide gusset plate strengthens a structure. Even in mill-building trusses where a stout kneebrace must take nearly all the wind stress, a big gusset plate riveted into the column makes the structure look more secure. There is no reason, however, why the coming generation of structural engineers should not have the advantage of a clear mental picture of secondary stress action and an understanding of the factors which influence it.

"Modern Framed Structures," Vol. II, contains considerable data from computation of secondaries. Maney's short cut of the slope-deflection method is the most rapid method I have seen in print, but that is not generally available for class-room use. Nevertheless the instructor in structural engineering could send his men out fairly well prepared to analyze secondary stresses or to minimize them in design, if it were not for the chorus of successful graduates of the middle ages, who tell the young engineer, "we never compute them." In late years, this has been somewhat overcome by the publicity given the secondary stress computations on several large bridges, and the interest that the design offices of large bridge companies are showing in the subject.

Your editorial and more discussions in the future will do much to help the instructor who is trying to make a class look upon secondary stress calculations not as advanced drill in calculus trigonometry and algebra but as a fundamental for men who are going to make structural design their life work. ALBERT SMITH,

Chicago, Dec. 13, 1923. Consulting Engineer.

Public Service Discouraged

Sir—I have been reading with a great deal of pleasure the articles that you have been presenting from time to time relative to the irrigation problems of the West, and more particularly with reference to the present "business attitude" of the Secretary of the Interior in his dealings with the Reclamation Service. As I have devoted much time in the past to the passage of the original Reclamation Act, and served thereunder for a term of years, and live in arid America, I am, of course, keenly interested in the present situation.

To my mind, the most serious aspect of this Reclamation situation lies in the fact that if high-grade men like Arthur P. Davis and F. H. Newell can be utilized for the creation of a great, meritorious organization, which subsequently is seized by politicians to be operated as a part of a machine for party benefit, then it is basically discouraging to attempt similar organization efforts with such institutions as federal roads, swamp reclamation, harbor improvements, forestry and the like. This discouragement not only applies to competent young men entering the public service, but to such work as we are endeavoring to do through our great commercial organizations. For instance, the Los Angeles Chamber of Commerce has very active committees that are endeavoring to build up legitimate public sentiment in favor of such projects as the Colorado River development, and when they are confronted with a situation such as has been developed, they naturally are discouraged in their efforts.

For these and other reasons, I think that you are fully

justified in using the great influence of your paper in persistently and vigorously condemning any such action on the part of public authorities. J. B. LIPPINCOTT,
Consulting Hydraulic Engineer.
Los Angeles, Calif., Dec. 5, 1923.

Ethics and Success

Sir—Your editorial, "An Experiment Worth Trying," of some weeks ago prompts certain reflections.

Probably the yet-to-be-unearthed Tel-el-Amana clay tablets, or the picture writings of prehistoric races, will on deciphering be found to contain well-meant advice to the aged engineer and architect, on how to get a job honorably, and the high ethical standards that ought to prevail in securing it.

The doctor, the lawyer, the dentist, all would starve to death if they lived according to the old theory of occupying a chair in their office and patiently waiting for customers. The practising engineer is in the same category: he must *get* the business.

Assuming "fitness" and "character," he must *make friends*, not alone those of family and boyhood, for rarely can they be counted upon; but the friends made through personal worth and their willingness to introduce, where introduction is of value, and in some cases even personally provide the start.

Competition is the keynote of the day, and that is inevitable throughout every year of the engineer's life, but there can be proper competition and *indecent* competition, and engineers have themselves most to blame for the latter.

A municipal board awakens to the need for an improved water plant, sewage works, refuse disposal system, modern pavements, etc. A local engineer may be quite worthy and even competent, but at the last election he worked for Councilman Jones, so as said Jones is in the minority, Mr. Engineer is out of it. Informal word goes out through the press and the board is swamped with letters from 1,000-mile range, "Me"—"Our Firm"—"My Esteemed Friend"—"We will be glad to advise you briefly without charge"—"Our experience is superlatively beyond that of all our confreres"—etc., ad nauseum.

What happens? The board is drowning; some active member says, call for engineering proposals; and that there may be a semblance of fairness, they do so upon a "Specification of Needs." And what a specification!

Then the deluge; every good-for-naught engineer (and unfortunately a few good) files his proposal and supporting data, and begins his drive to secure votes in the board. The board, usually an unremunerated body, has neither knowledge nor time for real investigation of merits, and with the fear of voters at the next election, if attention is given to other than the lower bidders, either throws up the job, or selects chiefly on the basis of insistent nerve and cheapness, thereby failing often to secure the competent man, and in the long run, putting the community to much greater gross expense.

This is no fancy picture, but a common occurrence.

The writer offers no cure, though absolutely out of sympathy with the method, which possesses no redeeming feature.

If engineering is to be considered a profession, and if the engineer is to be looked upon as one worthy to give, and charge for, advice, such practices must end.

The card in technical journals, papers before professional societies, experiments made and written up, attendance at and participation in engineering meetings, all help, but do not bring much bread and butter.

Membership and active service in civic organizations, appearances before municipal bodies, for other than self-exploitation, are excellent.

Letters of introduction to parties having work in charge, or responsibility for it, are perhaps the most powerful aids to landing the job, while in absence of such possibility a frank request for interview, or dignified offer of services and simple statement of qualification, with a few names for reference, may sometimes bring a reply and once-in-a-while land a job.

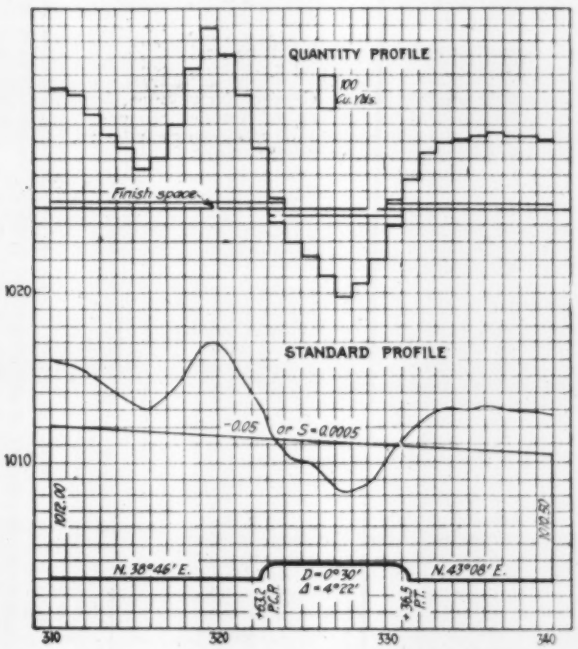
One piece of work well done usually leads to others.

In closing, at the risk of the senile charge, let the writer say, while much unfortunate fact exists as to contrary practice: "Ye cannot serve two Masters."

New York City, Dec. 20, 1923. LOUIS L. TRIBUS,
Tribus & Massa, Engineers.

Quantity Progress Profiles

Sir—The disadvantages of showing monthly progress of railroad or canal construction in colors or hatching on the standard profile platted on either plates "A" or "B" are well known. The distorted relation between elevation and volume, necessity of showing "finishing" as well as bulk movement of material, different methods of construction under different conditions, irregularity in application of force in different months, and the different free-hand styles or personal equations of the various resident engineers who compile the progress are the most conspicuous of these.



QUANTITY PROGRESS PLATTED SEPARATELY

Some fifteen years ago when the writer was in Idaho he was shown a progress profile in use on irrigation construction, of which the enclosed is a rough sample, made from memory. The system used was different hatching for each month's progress on the upper or quantity profile, made on transparent paper. Prints were taken from this, as required.

It seems that the quantity profile will give a more accurate view of progress than to hatch or color the lower profile; that the method is feasible for use on canal construction, and on plate "B" is adapted to railroad construction on light grades and not to irregular ground, but for mountain work would be impractical or would require the full width paper instead of the usual half width.

It is also evident that the quantity profile could not be platted until after the quantities had been computed and that probably considerable extra work and expense are involved.

In some twenty years of construction experience, the writer has never seen a satisfactory progress profile using the standard platting, and would like to learn from actual users their ideas on the "quantity profile" and whether the benefits from this same have warranted the additional trouble before putting it to actual use.

Nov. 24, 1923. Cope Rand Means Co., Engineers.
San Francisco, Calif., H. S. MARTIN,

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

The Municipal Docks and Terminals of Jacksonville, Fla. will earn a net profit of $80,000 this year according to an estimate made by the general manager.

The Annual Convention of the County Commissioners of Ohio will be held at the New Southern Hotel, Columbus, Feb. 5 and 6. This meeting will be followed by the convention of the Ohio Engineering Society, which will be held at the same hotel Feb. 7 and 8.

Col. Frederick Stuart Greene, New York State Superintendent of Public Works, it is understood will advocate in his recommendations to the legislature a tax on the sale of gasoline, which it is estimated would provide a fund of $20,000,000 yearly which could be used for maintenance of state and county highways, and render unnecessary legislative appropriations.

Report From the Contractor's construction camps at the Moffat Tunnel in Colorado stated that on Dec. 4 a total of more than 1,000 ft. had been driven in the two headings. The pioneer heading at the west portal had been advanced 654 ft. and the pioneer heading on the east end 400 ft. At the west end the bore is now in hard rock and since passing the point where timbering was necessary much more rapid progress had been made.

A Resolution Adopted by the Senate provides for extending the scope of the special deeper waterway committee of the Senate so as to provide for House participation in its membership. The resolution authorizes such a joint committee to continue the work already done by the Senate committee in investigating the problem of the 9-ft. channel from the Great Lakes to the Gulf of Mexico. Included in the proposition is the matter of the navigability of the Ohio and the Missouri rivers.

The Presidential Nomination of George K. Burgess to be director of the Bureau of Standards was confirmed by the Senate on Dec. 18. The Senate also confirmed the nomination of C. L'H. Ruggles to be assistant to the Chief of Ordnance with the rank of brigadier-general and of John W. Joyes to be assistant to the Chief of Ordnance with the rank of brigadier-general, and of Samuel McRoberts and John R. Delafield to be brigadier-generals in the Officers Reserve Corps.

The Spavinaw Water Project under construction to furnish water from the Ozark Mts. to Tulsa, Okla., is 70 per cent complete. The gravity concrete dam of 55 ft. maximum height on the Spavinaw Creek is nearly finished, the 10,000-ft. 84-in. tunnel will be completed by Feb. 15, 1924, and the 53 miles of 54- and 60-in. reinforced-concrete pipe line and pumping station at the end of pipeline should be completed in May, according to W. R. Holway, engineer in charge of the construction.

Accident on London Tube Subway Stops Traffic

In enlarging the diameter of the City & South London R.R., one of the first of the "tube" subways of London, England, an old storage well or cistern was pierced, causing an inrush of sand and water. This flow of material caused a great cavity to form, so that water and gas mains and electric conduits were broken. The gas finally exploded and blew up a section of the street, Newington Causeway, about 30 x 20 ft., but no harm was done before the broken main was shut off. The 18-in. tunnel enlargement was being carried on while traffic was maintained in the original tube, but after the accident all traffic stopped, arrangements being made to handle the passengers on adjacent bus lines.

Traffic was also interrupted temporarily on the Southern Ry., which crosses the street at this point, in order that the bridge foundations might be inspected, but it was found these had not been disturbed by the slide or the explosion.

Philadelphia Sesqui-Centennial Plans Suspended

Work for the sesqui-centennial exhibition in Philadelphia has been definitely suspended until after Jan. 1, 1924, when the new city administration in Philadelphia goes into office. Col. John Price Jackson has resigned as executive director of the Exhibition Association, and the salaried personnel has been reduced to three persons. Suspension of all work came during the unsatisfactory campaign to raise $5,000,000 by popular subscription, in addition to the $1,000,000 previously subscribed. It was precipitated by Mayor Moore's opposition to the plans of the Association. The mayor declared that the Association's plans (*Engineering News-Record* of Sept. 6, 1923, p. 403) though modified from the original proposals for an exhibition, were still too elaborate and extensive. Mayor-elect Kendrick has intimated that he is favorable to the sesqui-centennial exposition.

Agreement Makes New Construction Possible at New Orleans

By an agreement with the City of New Orleans the Louisville & Nashville R.R., has ceded to the Dock Board property along the levee at St. Joseph St., which has been the subject of dispute as to title for a number of years. In return, the railroad company receives assurance of undisputed rights to the land which it occupies back of St. Louis St., upon which it will now erect a storage warehouse at an estimated cost of $750,000.

The New Orleans Dock Board will erect a wharf and shed along the levee property which it has acquired, and which is expected to cost about $1,000,000.

New Hudson River Bridge Project For New York City

Plans for a highway bridge across the Hudson River in the upper part of New York City have been submitted to the Port of New York Authority by Governor Silzer, of New Jersey. The project was developed by O. H. Ammann, formerly deputy chief engineer of the New York Connecting R.R. It provides a single-span suspension bridge at Fort Washington Point, on a line lying between 178th and 179th St., New York, reaching the New Jersey bank at Fort Lee. The main span is 3,400 ft. long and the side spans each 700 ft. Double eyebar chains are the carrying members. They are spaced 90 ft. apart and provide for a roadway width of 80 ft. on the main deck, with footwalks outside. This main deck is assigned to highway use, and accommodates eight lines of vehicles. Four electric-railway tracks are placed on four narrow cantilever lower decks formed by bracketing out to either side of the posts in both stiffening-truss planes. The truss depth is unusually small, being only 35 ft.; the top chord is at the level of the main deck and the bottom chord at the level of the lower edge of the trolley brackets.

Mr. Ammann estimates the cost of the structure at $30,000,000 and its time of construction at four years. He claims that it will give quicker relief to cross-river traffic than any other crossing proposed. In conjunction with the existing Washington Bridge across the Harlem River it will provide a direct connection between New Jersey and the Westchester and New England regions without carrying the traffic through the congested midtown section of New York. Tolls are estimated to be sufficient to pay fixed and operating charges even in the first year after completion.

Kansas Engineering Society Holds Convention at Wichita

Outstanding features of the annual convention of the Kansas Engineering Society held in Wichita, Dec. 11-13, were an address by P. L. Brockway, city engineer of Wichita and president of the association, and a talk on aerial photography by Major L. B. Roberts. Mr. Brockway urged greater participation in civic affairs by engineers, asserting that engineering was closer related to business than any of the professions. Major Roberts explained in detail the use of aerial photography in reconstructing existing maps. Another interesting speaker was Clark Jacoby whose discussion of flood protection was directed mainly to rivers near Wichita.

The first day of the convention was devoted to various officers' and committee reports. Committee reports occupied most of the morning and afternoon sessions of Dec. 12. A highway symposium was the principal feature of the third day's session.

Dr. Elwood Mead Returns From Extended Trip Abroad

Returning from a nine-months trip to Australia and the Holy Land where he served as reclamation consultant for the British Government, Dr. Elwood Mead of Berkeley, California, noted irrigation engineer, began to serve Dec. 20 as a member of the special advisory committee appointed by Secretary of the Interior Work to study government reclamation.

Dr. Mead arrived in New York Dec. 19 from Jerusalem and went to Washington the next day, calling upon Secretary of the Interior Work before joining the committee. Dr. Mead was employed by the Australian Government for many years to organize the settlement activities on its irrigated lands and during his recent trip served on a British Commission to investigate the difficulties that have developed in connection with Australian reclamation. He also spent a month in Palestine where at the request of the Zionists he traveled over the country with a view of passing on the advisability of reclamation projects in the Holy Land.

Dr. Mead left Dec. 20 for Berkeley where he is a professor of rural institutions of the University of California and will join the special advisors when its members begin next month a tour of a number of reclamation projects in the West. Following this visit of the committee he will return with them to Washington and assist in the preparation of the final report of the committee that will be made to the Secretary of the Interior to be later submitted to the President and to Congress.

Convict Road Force of 102 Men Moved to New Job

The California Highway Commission on Dec. 5 and 6 moved 102 prisoners several hundred miles from a road camp on the Klamath river in Siskiyou county to Briceburg on Merced river where the convicts will begin a two-year job in building the state highway through the rugged Merced river region into Yosemite National Park.

The men and their equipment were moved from their Klamath river camp in trucks to the railroad station where two day coaches and two baggage coaches were waiting on a siding. Baggage, camp equipment and commissary were loaded into these cars which were then attached to a regular Southern Pacific train about noon. At Merced they were transferred to the Yosemite Valley R.R. arriving at their destination on the afternoon of the second day.

To Eliminate Grade Crossings

Following a joint conference between the state highway commissioner, the governor of Alabama, and officials of practically all railroads operating in Alabama, an agreement has been reached where the highway department will inaugurate a grade-crossing elimination program, in which the state will pay 50 per cent and the railroad 50 per cent of the cost. The agreement require only the formal approval of the chief executives of the railroads before it can be put into effect.

Minnesota Metropolitan Planning Commission Scheme

Progress on the formation of a Metropolitan Planning Commission for Minneapolis, St. Paul, and vicinity was made at a second meeting devoted to the subject held on Dec. 13 under the leadership of the Northwestern Section of the Am. Soc. C. E. With G. H. Herrold as acting chairman, the meeting on Dec. 13 arranged for two committees, one on organization and one on a tentative boundary line for the district, the latter consisting of E. H. Hewitt, Minnesota Chapter, A.I.A., A. M. Best, assistant to the vice-president, N. P. Ry., representing the Northwestern section, Am. Soc. C. E., and James T. Elwell, president, Minneapolis City Planning Commission. The plan is to have Metropolitan Planning Commission self-organized, but with a view to getting legislative legalization of the commission and its work.

Highway Traffic Officer

This is one of the Pennsylvania State Highway Department's motorcycle patrolmen. The innovation of detailing a special highway police force under the highway and not the police department, has but recently been established.

Milwaukee Zoning Ordinance Upheld by State Court

The constitutionality of the zoning ordinance of Milwaukee, Wis., was upheld by the State Supreme Court on Dec. 11. The decision upholds zoning as an exercise of the police power and denies that it results in taking private property for public use in such a way that compensation should be paid. The plaintiff sought to compel the building inspector of Milwaukee to grant a permit for a dairy building in a residence district from which business is excluded by the zoning ordinance. The opinion in part, was as follows:

"If, in the prosecution of governmental functions, it becomes necessary to take private property, compensation must be made, but incidental damages to property resulting from governmental activities or laws passed in the promotion of the public welfare is not considered a taking of the property for which compensation must be made.

"This is no new idea, although it has but recently taken the form of legislation. Everyone who has observed the haphazard development of cities, the deterioration in the desirability of certain residential sections by the encroachment of business and industrial establishments upon and into such sections, resulting in the consequent destruction of property values and in the ultimate abandonment of such sections for residential purposes has appreciated the desirability of regulating the growth and development of our urban communities.

"Fresh air and sunshine add to the happiness of the home and have the direct effect upon the well being of the occupants. It cannot be denied that a city systematically developed offers greater attractiveness to the house seeker than a city developed in a haphazard way. The one compares to the other as a well ordered department store compares to a junk shop."

Army Engineers Report Adversely on Tombigbee Deepening

Washington Correspondence

An adverse report has been made by army engineers on the project to deepen the Tombigbee River in Alabama and Mississippi and connect it by a canal with the Tennessee River. As a result of a preliminary survey made in accordance with the rivers and harbors act of 1922, the engineers have reported to Congress that the project would be costly, that 63 locks would be required, thus making it cumbersome, and that the proposed waterway would practically parallel the Mississippi River without material benefit to commerce.

While the item for the survey was included in the rivers and harbors act on the suggestion that commerce would be benefitted by the improvement, one of the other suggestions put forward by advocates of the project was that by connecting the Tombigbee and Tennessee rivers a means of relieving floods in the Mississippi River would be provided as flood waters from the Tennessee could be diverted to the Gulf through the canal. No mention of this subject is made in the engineers' report.

Work Progresses on Camden Terminal of P. & R.

Company Officials Confident New Terminal Will Be Ready for 1924 Seashore Season

Special Correspondence

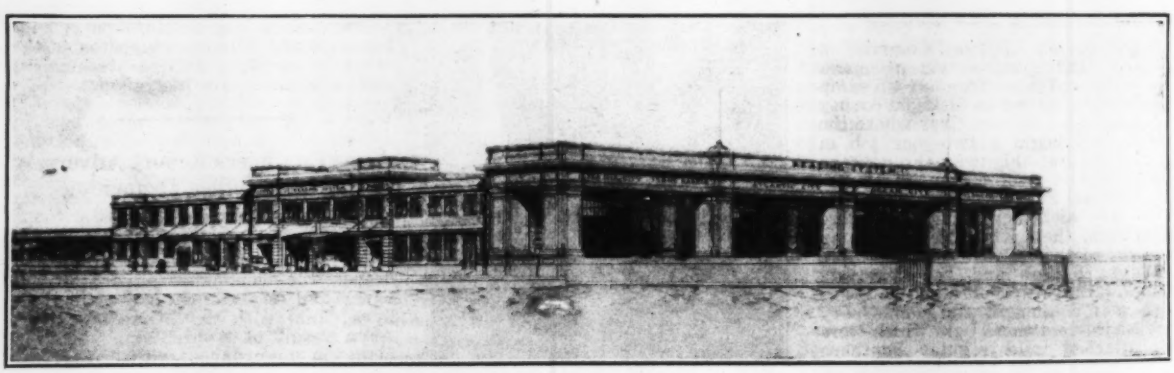
Rapid progress is being made on the construction of the new Camden, N. J., terminal of the Philadelphia and Reading Ry.'s seashore lines. Work on the laying of tracks, construction of the fill-in, the piling, erection of steelwork, used in connection with the terminal, signal tower and battery house to be butterfly shelters, and building of the has progressed so satisfactorily that officials of the company are confident the terminal will be ready for service by the opening of the seashore season in 1924.

The new terminal will be a thoroughly modern two-story structure of steel frame and brick with stone trimmings, on a concrete foundation built on piles. It will house the electrically-operated ferry slips, the trainshed containing 14 tracks, a concourse 328 ft. long and 105 ft. wide, waiting rooms for men and women, a restaurant, and the offices of the Delaware River Ferry Co. and of the Philadelphia and Reading Ry.'s seashore lines. The office building, on the land side of the terminal, will be a two-story structure 115 ft. long and 42 ft. wide. A brick power house is located at the opposite end of the concourse.

The hydraulic fill of 319,388 cu.yd. under the station proper, and the fill of 30,000 cu.yd. at the Jackson Street end of the terminal are now practically completed. Most of the creosoted wood piling used in the ferry slips is in place. All of the structural steelwork over the concourse has been erected, and a portion of the steelwork over the headhouses has been erected. All tracks, both those in the train shed and those in the yard adjacent, have been laid, and work has been completed on the intricate switches where the terminal tracks converge. The butterfly shelters over the train platforms are well under way.

The signal tower and battery house, which will be the largest on the Reading system, is about 50 per cent completed. It will be a three-story building of brick and concrete, 53 ft. long and 17 ft. wide. The first floor will be used for the storage of signal equipment and for the heating plant. On the second floor will be the generator and battery racks, the relay racks, and the general working apparatus of the tower. The third floor will be occupied by the lever room containing 75 lever frames which will control all of the traffic in and out of the terminal.

The ferry slips at the foot of Chestnut Street, on the Philadelphia side of the river, have been electrified in anticipation of the opening of the new terminal.



ARTIST'S SKETCH OF PHILADELPHIA & READING $3,000,000 CAMDEN TERMINAL FOR SEASHORE LINES

Wheeling, W. Va., Accepts Balmer Refuse Incinerator

The 70-ton garbage and refuse incinerator of the Balmer type, the first of the kind in the United States, has been accepted by the city authorities of Wheeling, W. Va. Some weeks before acceptance the plant was tested by H. L. Campbell, city engineer, and G. R. Kress, of Clark & Kress, a local engineering firm. In the report on this test it was stated that during a trial extending through a period of five or six days 14.84 tons were burned in 8 hr. or at the rate of 44.5 tons in 24 hr. —against the guarantee of 70 tons. The report contained no recommendation as to acceptance. Between the time the contract was let and the test made a city election resulted in a change of administration, including the mayor, at least a majority of the city council, and subsequent to the election, the city manager and city engineer. This change was considered locally to be unfavorable to the incinerator but, as stated, the plant has been accepted by the city.

Right to Double Wanaque Water Development Granted

The right to develop the Wanaque water supply storage to its full capacity of some 100 m.g.d., doubling the original amount, has been granted to the North Jersey District Water Supply Commission by the New Jersey Board of Conservation and Development. The commission has built the foundations for a dam at Midvale designed to store water to give 50 m.g.d. and work is well along on a contract for an 8-mi. tunnel to form a part of the conduit from the reservoir to Newark, for which city the Commission is carrying out the work. Recent decisions of Paterson and other municipalities to join the Wanaque project led to the application for the enlarged development just granted.

Drainage Congress Announces Program for Meeting

Papers listed for the program of the National Drainage Congress, at St. Louis, Jan. 16-17, are numerous and of varied character, as shown by the following partial list: "Drainage of Horicon Marsh," E. R. Jones, University of Wisconsin; "Drainage in Iowa," C. C. Ayers, Iowa State College; "Future Work in Louisiana," A. T. Dusenbury, New Orleans; "Results in North Carolina," Dr. J. H. Pratt; "Drainage Development in Relation to Rainfall and Wild Animal Life," E. V. Willard, Minnesota Commissioner of Drainage; "Adapting the Method of Reclamation to the Land," J. T. Stewart, St. Paul; "Expansion of Farming Area," Dr. L. C. Gray, U. S. Dept. of Agriculture; "Improved Methods of Long Term Financing," H. C. Wallace, Secretary of Agriculture; "Relation of Colonization to Reclamation," F. H. Newell, Washington, D. C.; "Cost and Cost Finding," L. S. Hidinger, Memphis, Tenn.; "What Drainage Has Accomplished," S. H. McCrory, U. S. Dept. of Agriculture; "Crops on Peat and Muck Lands," G. R. S. Elliott, University of Minnesota; "Fluctuation of Ground Water Level," S. A. Norling, Denmark; "Outlet Drainage," E. R. Jones, University of Wisconsin; "Land Reclamation and Game Reserves," C. H. Young, Muscatine, Iowa; "Wing Dams and Levees in the Mississippi Valley," Col. Potter, Mississippi River Commission; "Oil Engines for Dredges and Draglines," Geo. B. Massey, Chicago; "Drainage Legislation," R. B. Oliver; "Progress in the Everglades," F. C. Elliott, chief engineer, Okeechobee Project; "The Policy of the Interior Department in Regard to Western Reclamation," D. W. Davis, Chief of Bureau of Reclamation; "Value of Reclamation to the Railroads," Wm. Sproule, president, Southern Pacific R.R.

Highway Course in Tennessee

A short course in highway engineering for highway engineers is to be held at the University of Tennessee Jan. 7 to Feb. 2. The course is to be given under the joint auspices of the university and the state highway department. The course will include mathematics, computation and drawing, highway surveying, materials testing, a general course in highway engineering, highway economics, transportation, and highway organization.

Demolition Contracts Awarded for Delaware River Bridge

Award of four contracts for demolition work was made by the Delaware River Bridge Joint Commission at its meeting in Philadelphia on Dec. 21. Three of the contracts will be performed at a total cost to the commission of $17,863, while the fourth contract is on a basis that the contractor will pay the commission the sum of $2,812, making the net cost of the four contracts, $15,051. The demolition is to prepare the sites of the approaches for the bridge on the two sides of the river. Bids were received on nine sections, four being on the New Jersey side of the river and five on the Philadelphia. Three of the Philadelphia bids and two of the Camden bids were rejected, and these portions of the work will be readvertised for bids to be received on Jan. 16, 1924.

Sacramento's New Water Filters To Be Started Dec. 31

Sacramento's new 48-m.g.d. water filtration plant is to be put in operation New Year's Eve. President Coolidge will press a button in the White House connected by wire with the control board at the filter plant. A three-day celebration in Sacramento will follow.

Engineering Societies

Calendar

Annual Meetings

FEDERATED AMERICAN ENGINEERING SOCIETIES. Washington, D. C.; Annual Meeting, Washington, D. C., Jan. 10-11, 1924.

AMERICAN ROADBUILDERS' ASSOCIATION, New York City; Annual Convention, Chicago, Jan. 14-18, 1924.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York, Jan. 16-18, 1924.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual Meeting, Chicago, Ill., Jan. 21-24, 1924.

ENGINEERING INSTITUTE OF CANADA, Montreal; Annual Meeting, Montreal, Jan. 22, and Ottawa, Jan. 23, 24, 1924.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Meeting (20th anniversary), Chicago, Ill., Feb. 25-28, 1924.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago, Ill.; Annual Meeting, Chicago, March 13-15, 1924.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, New York City, May 19-21, 1924.

The Minnesota Federation of Architectural and Engineering Societies will hold its third annual convention Feb. 1 and 2, 1924 at Duluth.

The Dayton, Ohio, Section of the American Society of Civil Engineers has elected the following officers: J. H. Kimball, president, for one year; and J. K. Grannis, vice-president, for two years. C. D. Putman, vice-president, and C. H. Eiffert, secretary-treasurer, remain in office for another year. At this meeting, E. W. Lane, who has just returned from three years' work in China, gave an interesting talk on "Flood Problems on the Huai River."

The Engineers' Club of Trenton, N. J., announces the opening of its new headquarters in the Stacy-Trent Hotel, Trenton. H. G. Acock is secretary of the club.

The Engineers Subdivision, Chicago Association of Commerce, Dec. 19, elected the following officers: J. L. McConnell, chairman, and Frank D. Chase, vice-chairman.

The South Dakota Engineers' Society will hold its annual meeting at Huron, So. Dak., Jan. 9 and 10. The annual dinner and some of the sessions will be held jointly with the Associated Contractors of South Dakota. R. E. Bragstad, Aberdeen, So. Dak., is secretary of the engineers' society; H. Rettinghouse, of Sioux Falls, is president.

Personal Notes

RIVERDALE CONSTRUCTION CO. announces change of address from 1440 Broadway, New York City, to 2511 Grand Central Terminal, New York City.

IVAN E. GOODNER, Olympia, Wash., chief engineer of the department of conservation and development in the state of Washington, has resigned to go into private practice in California, and his resignation also severs his connection as chief engineer of the Columbia Basin state survey. Mr. Goodner has served as chief engineer of the Paradise Irrigation District in California, assistant division engineer of the Miami Conservancy District, Dayton, Ohio, and chief engineer of the Columbia Basin irrigation project in Washington.

ALLEN CLARDY has been appointed county road engineer for Christian County, Kentucky, with headquarters at Hopkinsville, Ky. He succeeds J. H. Dillman who had been county engineer for a year.

D. W. COLE, formerly of Marietta, Ga., who was in the U. S. Reclamation Service from 1904 to 1919, is now connected with the engineering department of the Electric Bond & Share Co., New York City. In the U. S. Reclamation Service, Mr. Cole was engineer on the construction of the Shoshone Dam in Wyoming, engineer in charge of the Truckee-Carson irrigation project and construction of the Lahontan Dam in Nevada, and senior engineer and resident manager of the Boise project, at which time he was senior engineer of the Western district of the Reclamation Service. He has also been engaged in various municipal water-works and in power developments.

P. F. AUER, who is now located in Little Rock, Ark., as resident engineer for James Stewart & Co., general contractors, changed to this work from being field engineer for the St. Louis Coke & Chemical Co.

CLAIR A. INSKEEP has changed location from county maintenance engineer of Logan County, Ohio, to civil engineer on surveys and construction for the Biscayne Engineering Co., and his new address is Miami, Florida.

JAY J. MORROW, Corps of Engineers, has been made a brigadier general in the Engineer Officers' Reserve Corps. General Morrow is governor-general of the Canal Zone. He has served as chairman of the Alaska Railroad Commission, and as chief engineer of the First Army, A. E.E F., in France.

QUINCY B. NEWMAN has been appointed chief engineer of the U. S. Coast Guard, and his appointment was confirmed by the Senate on Dec. 19.

LEWIS E. ROBERTS, formerly resident engineer on levee and drainage work with T. N. Jacob of St. Louis, Mo., has gone into private engineering practice in Peru, Ind.

JAMES H. RYAN is now bridge design engineer for the Missouri State Highway Department. He was formerly structural draftsman with the Shoemaker Satterthwait Bridge Co. at Pottstown, Pa.

CHARLES H. OSBORNE, builder and consulting engineer, has been appointed building inspector for Baltimore by Mayor Howard W. Jackson. Mr. Osborne held the same position several years ago. He succeeds J. Frank Crowther.

J. H. BRAY, recently assistant engineer for Red River County, Texas, has been appointed county engineer of Van Zant County, at Canton, Texas.

Obituary

JAMES FINLAY, for many years erector superintendent of the Dominion Bridge Co., in Canada, died in Vaancouver, B. C., Dec. 11. One of Mr. Finlay's most notable achievements was the placing of the two large spans of the Canadian Pacific Ry. bridge over the St. Lawrence River at Lachine, Que., in 1913.

LIEUT.-COL. GEORGE E. GIBSON, engineer, Albany, N. Y., died at his home in that city Dec. 19, aged 43 years. Colonel Gibson served through the war as engineering instructor at Madison Barracks.

JAMES E. HOOD, Mack, Colo., general manager of the Uintah Railway Co., Colorado, died Dec. 16 from an accident received on the line Dec. 13. Mr. Hood was born in Pennsylvania in 1869 and was a graduate of Allegheny College, Pittsburgh. His early service was in the engineering department of the Erie R.R., for which road he was rataed division engineer. He entered the service of the Great Northern Ry. and worked on the construction of that line into Spokane and Seattle from Havre, Mont. In 1910 he was appointed superintendent of the Chicago, Milwaukee & St. Paul Ry. During the war he was commissioned a lieutenant, going to Siberia where he was promoted through the various grades to major. He was made general manager of the Uintah Ry. in 1921.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Income Tax Returns Show Size of Various Industries

Corporation returns to the Bureau of Internal Revenue show that 356,397 concerns made tax returns in 1921. Of that number, 171,239 had a net income of $4,336,047,813. On that amount they paid a total tax of $701,575,432. There were, however, 185,158 of the corporations reporting that had deficits rather than income. The aggregate of those deficits was $3,878,219,134. Detailed figures for certain industries related to the engineering field are as follows:

Industry	No. of Corporations	Net Income	Total Tax
Chemicals:			
Paints and varnishes	664	$7,591,201	$1,217,053
Quarrying:			
Stone	493	5,955,125	894,934
Clay, sand, gravel	720	5,428,312	920,448
Stone, clay and glass:			
Cut building stone, etc.	1,495	28,304,171	4,724,338
Brick, tile, terra cotta	1,600	20,300,342	3,586,023
Glass and glass products:			
Plate and window	552	20,423,723	3,611,746
Combinations, of stone, clay and glass manufacture	34	738,263	109,521
Rail transportation:			
Steam railroads	609	291,113,607	29,650,857
Electric railroads	458	33,843,158	3,847,446
All other railroads	394	30,861,445	3,816,544
Total rail transportation	1,461	355,818,210	37,314,847
Other public utilities:			
Electric light and power companies	1,900	61,207,294	7,754,355
Gas companies	569	22,008,381	3,173,271
Telephone and telegraph companies	3,949	113,040,515	12,912,536
Waterworks	1,459	11,827,922	1,193,438

The gross income of corporations in the various groups is shown by the following:

Industrial Groups	Total No. of Corporations Reporting	Gross Income
Mining and quarrying	17,660	$3,888,876,370
Transportation and other public utilities	19,105	9,000,656,163
Chemicals	5,924	3,878,880,302
Stone, clay and glass	3,681	953,756,897
Metal and metal products	15,536	9,805,138,797

Lumber Standardization Adopted By Unanimous Action

The national conference on lumber standards, held in Washington, D. C., Dec. 12 and 13, agreed to a generally satisfactory compromise on the vexed questions of the dressed thickness of standard boards and dimension. It was unanimously voted to set up a standard of $\frac{13}{16}$ in. for standard boards, with $\frac{25}{32}$ in. as extra standard; and a standard of $1\frac{5}{8}$ in. for dimension and $1\frac{3}{4}$ in. for extra standard dimension.

The recommendations of the Central Committee on Lumber Standards provided for a minimum standard. The adoption of the "extra standards" was made to meet the views of the retailers who favored $\frac{25}{32}$ in. as the single standard for boards and $1\frac{3}{4}$ in. for dimension. Secretary Hoover characterized the action taken as "the greatest forward movement in the direction of public service ever made by the lumber industry."

The remainder of the Central Committee's recommendations were adopted with minor changes and the committee was instructed to proceed with the consideration of the question of short and odd lengths, rough-dry sizes, box lumber, mouldings and other subjects and report again next May.

Big Output of Motor Vehicles

Production reports totalling 325,125 cars and trucks made in November, submitted at the directors meeting of the National Automobile Chamber of Commerce Dec. 6, bring the 11 months output to 3,717,709 which indicates that the year's total will reach 4,000,000. This will be a gain of more than 50 per cent over 1922, which was in itself a record year.

Register Trade Marks Abroad, Commerce Dept. Urges

It has been one of the regrettable features of American trade abroad, according to the Department of Commerce, that until recently insufficient attention has been given to the means of protecting and reserving to the original owner the value attaching to a brand mark. Under the United States law a right in a trade-mark is obtained simply through continued use, without any further steps on the part of the originator of the trade-mark. In the majority of foreign markets, however, the right is regarded as being vested in the first person who makes public claim to the mark through registration with the local patent office.

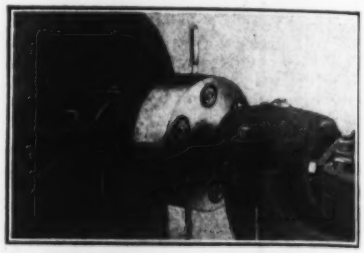
Even in those countries where consideration is given to the fact of prior use, and infringements may be contested under common law, the simple and relatively inexpensive process of registration of a trade-mark is a desirable thing, since it creates prima facie evidence of ownership in case of dispute and affords a basis for obtaining damages from infringing concerns. Trade-mark registration is decidedly less expensive than trade-mark litigation, and there should be included, as part of every enlightened export program, an examination of the means for protecting the value of the trade-mark in the new markets just as soon as the article begins to show promise of appreciable sales in the particular country.

Lining Up Turbine-Driven Pumps To Kill Vibration

Practical Suggestions Made for Leveling Bed-Plate and Securing Even Bearing of Coupling Faces

GEARED turbine-driven centrifugal pumps now used for supplying cities with water are less heavy than reciprocating pumps, and as they contain no unbalanced reciprocating masses they are also less apt to produce vibration, generally requiring less costly foundations. Because of their high rotational speed, however, great care must be applied to insure correct alignment. The following notes on testing for alignment embody practice recommended by the De Laval Steam Turbine Co., Trenton, N. J.

In handling a large bed-plate for the support of a geared turbine-driven centrifugal pump care should be taken to avoid distortion by shock in handling. Although the bed-plate may have ample depth and rigidity for its purpose when properly supported, cast-iron, like all other metals, is flexible and will distort appreciably under stress. It may even receive a permanent set so that it will be difficult to pull it back into its original alignment. It is therefore advisable to keep the machine on the skids on which it was originally shipped until it is placed on its foundation.



LINING UP UNITS WITH "FEELER" BETWEEN COUPLING FLANGES

Leveling the Bed-Plate

An easy way to level the bed-plate on its foundation is to place small steel plates with taper wedges under the edge of the bed-plate, driving up on the wedges until the proper alignment and level are obtained. These wedges should be placed from 12 to 15 in. apart on small machines, and 24 to 30 in. apart on large machines. The planed surfaces of the bearing brackets may be used as leveling pads after removing the bracket caps. After the leveling has been completed, however, tests should be made for correct alignment by examining the two halves of the flexible coupling to see that their faces are parallel and that the center lines of the shafts coincide. The couplings used in De Laval pumping units, as shown in the accompanying photograph, are accurately finished on the periphery and on the inside surface by means of a grinding machine at the factory so that they run perfectly true and can be depended upon in correcting alignment.

Checking Coupling Alignment

When checking the alignment of a coupling the bolts can be removed so that the two halves are entirely free. First insert a leaf-gage or feeler between the two halves at a number of

points; the space should be uniform around the circumference or should not vary more than 0.002 in. A steel straight-edge can then be placed across the two coupling halves and should have an even bearing on their surfaces. This checking by means of a straight-edge should be done at not less than four points evenly spaced around the circumference. If the coupling is not in correct alignment, it will not operate satisfactorily at high speeds, and will tend to produce vibration and strain in the bearings and shaft. Excessive wear of coupling pins or bearing is an indication of poor alignment.

When the alignment has been completed the bed-plate should be filled partly or wholly with cement grout in order to maintain alignment and prevent distortion by piping or other strains. Foundation bolts are not necessary, but may be advisable to assist in maintaining alignment. After the grouting has set the alignment should again be checked, as in rare cases the swelling of the cement causes a slight distortion.

In attaching piping to the pump care should be taken to see that the flanges fit properly. If they do not come parallel and do not meet they should not be pulled up with flange bolts, as this may strain the pump casing, bedplates and piping, and will invariably result in distortion, with possible vibration or breaking of pump casing or piping.

Business Notes

THE LITTLE RED WAGON CO., Omaha, Neb., announces that it has purchased the business of Stroud & Co. and will continue the manufacture of the Stroud line of road-making machinery, including elevating and blade graders, scrapers, dump wagons, plows and road drags.

SMITH ENGINEERING WORKS, Milwaukee, has opened a branch office at 50 Church St., New York in charge of Donald D. Barnes, formerly district manager in Chicago. Mr. Barnes is an engineer with wide experience in design of quarry and gravel plants. The Chicago office will be continued in the Old Colony Building under management of Victor H. Jones, formerly associated with American Blower Co.

C. B. ADAMS and S. P. HOLMES have incorporated under the name C. B. Adams & Co., Chicago, to represent the Union Iron Works of Erie, Pa., manufacturers of steel water-tube and fire-tube boilers; the Erie Engine Works, of Erie, Pa., manufacturer of slide-valve engines; and the Sims Co. of Erie, Pa., manufacturer of water-heating apparatus.

BARBER ASPHALT CO. has installed a new power plant at its works in Maurer, N. J., to supply steam, electricity and compressed air to its three manufacturing units, the roofing plant, oil refinery and asphalt plant. The new building is 115 ft. long with boiler room 75 ft. wide and engine room 41 ft. wide. There are five 520 hp. boilers, and a 300 and a 500 kw. turbine. While the boilers are stoker equipped all but one unit are fitted for burning fuel oil, one of the company's products. Lockwood, Greene & Co. were engineers for the plant.

SEATTLE MACHINE WORKS announce that experiments on the Johnson airless injection Diesel engine have been completed. The company is now preparing to manufacture these machines for marine service, electric generating sets and contractors' equipment.

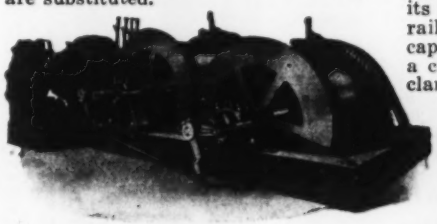
Equipment and Materials

New Heavy Duty Hoists

A new heavy-duty hoist, adaptable to cableways, tail rope systems and general haulage, has been added to the line of the Treadwell Engineering Co., Easton, Pa. The equipment is operated by electric motor and special attention has been given to the elimination of cast iron in the brake mechanism.

The frame is a gray-iron box type casting with motor and intermediate shaft bearings mounted on it, thus insuring perfect alignment. Bearings are of cast iron, of the pedestal type, and bearing caps are machined at the joints. All bolts are provided with lock-nuts. To insure absolute rigidity the bearings and pedestals are provided with machined tongues which fit into grooves in the frame. Gears are either of semi-steel or cast steel, with cut teeth.

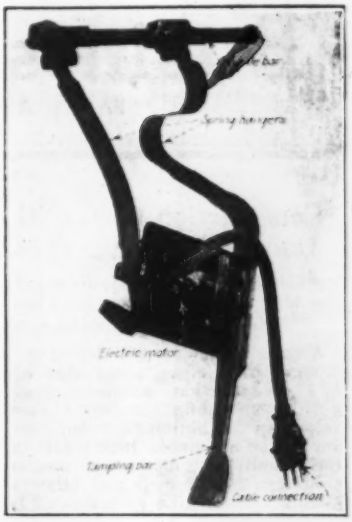
The friction clutches are of the single-face cone type operated by a screw thrust. The drum consists of two heads or flanges bolted to and supporting a cylindrical shell of cast iron. Each drum is provided with one or two brakes, as ordered, of the differential type. For ordinary service hardwood blocks are used as the brake lining, but for heavy duty asbestos-treated blocks are substituted.



These hoists are built in four sizes equipped with electric motors of 100, 150, 225 and 300 hp. respectively, these ratings being based on a rope speed of 400 ft. per minute.

Electric Tie Tamper

The latest form of the Jackson electric tie-tamping machine, made by the Electric Tamper & Equipment Co., Chicago, delivers about 60 strokes per second, each stroke having a force estimated at 600 lb. This tamper is said to work well in stone, gravel, sand and cinder ballast. The revolving element of the motor is mounted on a nickel-steel shaft running in ball bearings and having at one end an unbalanced weight which revolves at 3,600 r.p.m. and sets up powerful vibrations in that end of the motor casing to which the tamping bar is bolted. The handle is attached to the motor casing by spring plates.



In moving, the tamper is not lifted but is dragged, its weight being carried on the curved spring. Current is furnished by a portable plant having a 5-hp. gasoline engine belted to a 1½-kw. 110-volt motor. This power unit, weighing about 500 lb., will operate four tampers and such other track tools as bond drills and rail saws. With a 250-ft. electric cable work can be done for a distance of 500 ft. with one set-up of the power unit, but longer cables may be used.

Publications from the Construction Industry

Revolving Car-Dumper — WELLMAN-SEAVER-MORGAN CO., Cleveland, has issued an illustrated 8-p. bulletin on its revolving dumper for unloading railway freight cars of all sizes and capacities. The equipment consists of a cradle which, after the car has been clamped within it, revolves, dumping the contents in only a fraction of the time that would be required by other means of hand or mechanical unloading. The car-dumpers are designed for a normal capacity of 20 cars per hour.

Track Drainage—W. S. DICKEY CLAY MFG. CO., Kansas City, Mo., has issued a 60-p. booklet on the use of vitrified pipe for ordinary drainage of railway track, roadbed and yards, and also for the elimination of wet spots which make maintenance expensive. Numerous installations are illustrated. Incidentally the pamphlet deals with the use of this pipe for culverts, pile protection, well casing and small septic tanks at shops and stations.

Railway Station Heating—AMERICAN RADIATOR CO., Chicago, has issued a 16-p. illustrated pamphlet on the Ideal-Arcola boiler, radiator and hot-water circulating system specially designed for small railway stations which have no basement for a heating plant and where the agent is the only attendant. This system is applicable also for signal and interlocking towers and other small structures.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Construction Possibilities During the Coming Year

Probable Extent of 1924 Building Shown —Also Value of Plumbing, Heating, Lighting and Painting Jobs

With a $6,000,000,000 building year drawing to a close, some idea of the 1924 construction prospect may be gained from the figures shown herewith.

Commercial buildings formed 30 per cent of the estimated 1923 total; industrial buildings 9 per cent; residential buildings, 28 per cent and other engineering construction exclusive of buildings, 33 per cent.

Based upon the above percentages, the probable extent of 1924 construction in the classes mentioned, will be as follows:

Streets and Roads	$1,250,000,000
Industrial building	350,000,000
Commercial building	1,350,000,000
Residential building	550,000,000
Other construction	1,500,000,000

The money values of possible jobs in the estimated 1924 program will be as follows:

	Industrial Building	Commercial Building
Plumbing	$1,750,000	$27,000,000
Heating	12,600,000	67,500,000
Lighting	9,695,000	47,250,000
Painting	11,060,000	27,000,000

Present New York Building Wage Scale To Hold During 1924

The Building Trades Employers Association of New York City has decided to maintain during 1924 the same wage scale and bonus paid throughout 1923. A higher wage scale would perhaps hinder and in many cases block construction that is now needed. Present indications point toward intensive operations for the coming year. With increased activities in the construction lines ahead, there does not seem to be any likelihood of non-employment.

The United States Bureau of Labor reported in September that the cost of living this year was 75.4 per cent higher than 1914.

A table of wage increase over a period of nine years will show how this cost of living has been met and also how it has affected construction costs. The per cent increase in each trade since 1914, is shown as follows:

Kind of Labor	Daily Wage 1914	Daily Wage 1923	Per Cent Increase
Cement masons' laborers	$2.62	$7.50	186.2
Cement masons	5.00	10.00	100.
Bricklayers' laborers	3.00	8.00	166.6
Bricklayers	6.00	12.00	100.
Engineers, hoisting	6.00	12.00	100.
Carpenters (Bronx, Brooklyn, Queens)	4.50	10.00	122.2
Plasterers' laborers	3.25	8.50	161.5
Plasterers	5.50	12.00	118.1
Stone masons	4.80	12.00	150.
Derrickmen and riggers	4.00	9.50	137.5
Sheet metal workers	5.00	10.00	100.
Plumbers	5.50	10.00	81.8
Steamfitters	5.50	10.00	81.8
Tile layers	5.50	10.00	81.8

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 347 to 356, are the following:

Power Station, Sumner, Wash., to Stone and Webster, Inc., $1,060,000.

High School, Brooklyn, N. Y., to Turner Constr. Co., $2,045,000.

Current Freight Rates Compared With 1921-22

Due almost entirely to reductions in freight rates, made both voluntarily and by order of the Interstate Commerce Commission, the freight bill of the people of this country was approximately $431,000,000 less during the first eight months this year than it would have been if the rates existing during the corresponding period of 1921 had remained in effect.

Compared with the rates in effect during the first eight months of 1922, the freight bill this year represents to the shippers of this country a reduction of approximately $282,750,000 due to the voluntary reduction on agricultural products that became effective on Jan. 1, 1922, to the general rate reduction of 10 per cent effective on July 1, 1922, and to a number of individual readjustments in freight rates.

These estimates, which are made by the Bureau of Railway Economics from reports filed by the carriers with the Interstate Commerce Commission, are based on the freight traffic transported by the carriers from Jan. 1 this year to Sept. 1, which has been the heaviest in history.

Business Briefs

Call money steady at 4½ per cent as of Dec. 21.

Time money market dull with rate at 5 per cent.

Commercial paper rate 5 per cent with very little in the market.

Foreign exchange declines. Sterling, $4.34⅜; last week, $4.36⅞; year ago, $4.64⅜. Franc, $0.0510½; last week, $0.0530½; year ago, $0.0743¾. Lira, $0.0431½; last week, $0.0435; year ago, $0.0512½.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for in Construction News, pp. 347 to 356, are the following:

Hotel, Minneapolis, Minn., Calhoun Beach Holding Co., $1,300,000.

Apartment, New York, N. Y., I. Kraft, $1,500,000.

Recent Unit Bids Throughout the Country

The accompanying table gives the accepted prices of materials and operations in various parts of the country taken from contracts awarded during the last month.

The unit bids form an index of construction costs in outlying districts. A thorough knowledge of cost conditions may be had by reviewing the bid prices published weekly in the Construction News section of *Engineering News-Record.*

UNIT BID PRICES ON MATERIALS AND OPERATIONS FROM RECENT CONTRACTS AWARDED

Where Located	E.N.R. Issue	Nature and Extent of Job	Unit Bid Price
Ala., Fayette	Nov. 22	Digging 2 mi. ditch 10 ft. wide	$147,000.00
Ark., Walnut Ridge	Nov. 29	236,000 cu.yd. excav. drain. ditches, per cu.yd.	0.11
Ark., Russellville	Nov. 29	1 mi. grading and conc. surfacing	25,000.00
Ark., Little Rock	Dec. 6	3 in. asphalt top, per sq.yd.	1.44
		6 in. conc. base, per sq.yd.	1.35
Ark., Mena	Dec. 6	16 mi. grading and gravel surfacing	90,000.00
California	Dec. 20	460 tons, 70 lb. rails, per ton	52.50
		325 tons high T rails, per ton	59.43
		Joint plates, per cwt.	4.42
Calif., Stockton	Nov. 22	2,900 cu.yd. grading, per cu.yd.	.50
		5,390 tons gravel, per ton	2.25
		52,500 sq.ft. grading, per sq.ft.	0.01
Calif., Oakland	Dec. 6	50,400 sq.ft. 2 in. Warrenite bitulithic on 6 in. conc. per sq.ft.	0.30
		15,982 sq.ft. oil macadam pave., per sq.ft.	0.11
		7,022 sq.ft. cement walks, per sq.ft.	0.16
Calif., Oakland	Dec. 20	15,088 lin.ft. 8 in. vitr. sewer	34,500.00
Colo., Denver	Nov. 22	Excavation and grading, per cu.yd.	1.60
		Removing old soil and replacing with new, per cu.yd.	2.50
La., Bastrop	Nov. 29	25 mi. 8 in. gas pipe line	25,000.00
Michigan	Nov. 22	34,946 cu.yd. excav., per cu.yd.	0.55
		74,760 sq.yd. 8 in. rein.conc. pave., per sq.yd.	1.60
		29,742 cu.yd. excav., per cu.yd.	0.38
		54,393 sq.yd. gravel surface, per sq.yd.	0.625
Minn., St. Paul	Nov. 22	27 tons asphalt, per ton	22.66
		5,000 lb. solder, per cwt.	22.20
Nev., Lovelock	Dec. 6	336,495 cu.yd. excav., per cu.yd.	0.1375
		26,000 cu.yd. grading, per cu.yd.	0.60
O., Akron	Dec. 6	3,400 sq.yd. brick gutter, asphalt filler, per sq.yd.	2.35
		16,800 sq.yd. asphalt willite pave., plan B, Trinidad, per sq.yd.	1.85
		75,000 cu.yd. com. excav., per cu.yd.	0.37
		35,000 cu.yd. solid rock excav., per cu.yd.	1.15
Oregon	Dec. 13	2,170 lin.ft. 12 in. corrugated galv. i. pipe, per lin.ft.	1.25
		22,290 sq.yd. conc. pave., per sq.yd.	2.65
Tex., Center	Nov. 22	7,500 cu.yd. gravel, per cu.yd.	1.60
Tex., Ft. Worth	Dec. 13	7,900 gal. Texaco macadam binder, per gal.	0.06

Foreign Projects of Interest to Americans

A number of foreign construction projects which should be of interest to American engineers, contractors and manufacturers has been reported by the United States Department of Commerce. They are noted here, further information being available at the Bureau of Foreign and Domestic Commerce or its district co-operative offices, when a reference number in given.

Pipe Line company's official now in New York relative to the purchasing of supplies. American firms interested may secure this official's New York address and other information concerning the Colombian Concession. Reference No. Colombia 35XA.

Bids for railway construction is desired by South American country. The line is to connect two important cities. Bids close Jan. 20, 1924. Reference No. 113,170.

American contractor's service desired in Japan by the owner of a large building property. Contractors already at work in Japan may be interested. Reference No. 113,181.

Sugar mill to be constructed in a Brazilian State. The project will involve an expenditure of about $200,000.

Canning factory for South American country. The machinery to be installed is to come from America, about $60,000 worth. This may be a forerunner to an extensive outlay.

Wire nail factory for American branch house in Mexico. The president of the firm in question is desirous of receiving quotations on nail machinery of 2-ton per day capacity and information concerning nail-polishing machine. Reference No. 113,166.

Enlargement of waterworks and public building in Rumania. The municipal engineer of a city in Rumania is quoted in part as follows: At present the city would grant to an American contractor not only the constructing of the waterworks and canalization (sewage), but the building of the public market hall, the development of the electric plant and of the management of all this works. Reference No. 111,822.

Cold-storage plant for Brazil. The name of the company and the city where this plant is to be erected is available for interested American firms.

Public works planned by city in China as follows: street building, waterworks system, electric light and power plant. Finances of the municipality reported sound. Reference No. 815X.

Paving Brick Shipments Remain High

Considering seasonal influences, shipments of vitrified paving brick for November ran considerably above normal,—64 per cent of the industry's tonnage reporting total shipments of 21,689,000 according to a report just made to the U. S. Department of Commerce by the National Paving Brick Manufacturers Association. In October 66 per cent of the industry's tonnage reported shipments of 34,287,000.

Unfilled orders on hand declined from 64,531,000 for October to 54,535,000 for November. For the first time since last spring the total number of brick manufactured for the month ran greatly in excess of shipments indicating that companies are manufacturing for stock in anticipation of late winter and early spring shipments.

Future Transportation Needs

That the future transportation needs of the country have been thoroughly studied, is shown by recent reports of the Transportation Conference's Committee on Governmental Relations to Transportation. The committee reports that in the next ten years the freight volume will be one-third more than at present; passenger traffic one-fourth more. In order to meet this demand, there must be 38,350 additional miles of track; 13,200 more locomotives; 725,000 freight cars; 12,300 passenger cars. These additions will cost approximately $5,339,874,000.

(*Continued on p.* 1080)

Recent Unit Bids on Large Bridge Contract

Bids were opened by State Highway Comm. at Trenton, N. J., Nov. 27, for a bridge over the Raritan River between Perth Amboy and South Amboy, N. J. (a) Stillman, Delehanty, Ferris Co., 1 Exchange Pl., Jersey City, (awarded contract); (b) F. Snare Corp., 114 Liberty St., New York; (c) P. McGovern, 50 East 42nd St., New York. This is Federal Aid Project No. 20, the main bridge consisting of 1,536 lin.ft. steel plate girder spans carried on concrete piers, supported on pile and faced with granite, and 360 ft. span. The unit bids are as follows:

	A	B	C
Necessary clearing of right-of-way, etc., complete (lump sum)	$4,973 00	$14,000 00	$28,000 00
3,418 cu.yd. excavation, roadway cut, north approach, including grading	3 50	2 00	6 25
62,119 cu.yd. earth fill, north approach, including grading	3 00	1 60	5 00
72,950 cu.yd. earth fill, south approach, including grading	3 50	1 60	5 00
5,310 cu.yd. excavation, piers 1 to 9 and ret. wall, north approach	5 00	7 00	5 45
14,495 cu.yd. excavation, piers 10 to 12 and 16 to 28 inclusive	8 00	15 00	12 40
12,593 cu.yd. pneumatic excavation, piers 13, 14 and 15	23 00	17 00	32 50
556 cu.yd. pneumatic rock excavation, piers 13, 14 and 15	120 00	40 00	56 25
8,287 cu.yd. excavation, piers 29 to 55 incl., drainage ditches, etc.	5 00	9 00	8 65
2,040 lin.ft. piles 30 ft. length	2 85	.75	.50
9,270 lin.ft. piles 40 to 49 ft. length	2 24	.90	.50
23,777 lin.ft. piles 50 to 59 ft. length	1 74	.80	.55
61,072 lin.ft. piles 60 to 69 ft. length	1 77	.90	.70
58,204 lin.ft. piles 70 to 79 ft. length	1 61	1 00	.70
44,940 lin.ft. piles 76 to 78 ft. length (creosoted)	1 32	1 50	1 65
98,998 lin.ft. piles 80 to 89 ft. length	1 59	1 10	.85
34,567 lin.ft. piles 90 to 95 ft. length	1 45	1 20	.90
3,491 cu.yd. 1:2½:5 plain concrete, piers 1 to 9 and 29 to 55, inclusive, and retaining walls	12 00	18 00	15 50
6,509 cu.yd. 1:2½:5 plain concrete, piers 10 to 12 and 16 to 28, inclusive	15 00	33 00	15 25
9,024 cu.yd. 1:2½:5 plain concrete, piers 13, 14 and 15	20 00	40 00	12 50
888 cu.yd. 1:2:4 plain concrete, piers 2 to 9 and 29 to 54, inclusive	20 00	20 00	17 00
3,750 cu.yd. 1:2:4 plain concrete, piers 10 to 12 and 16 to 28, inclusive	25 52	34 00	17 00
4,608 cu.yd. 1:2:4 plain concrete, piers 13, 14 and 15	18 70	40 00	14 25
1,250 cu.yd. 1:2:4 concrete, retaining wall, north approach, including straps	21 61	20 00	25 00
1,990 cu.yd. 1:2:4 reinforced concrete, cols. beams and piers	28 40	24 00	34 00
1,569 cu.yd. 1:2:4 reinforced concrete, piers 10 to 13 and 15 to 28	15 00	24 00	34 00
3,853 cu.yd. 1:2:4 reinforced concrete, girders, slabs, etc.	30 00	32 00	29 00
2,450 cu.yd. 1:2:4 reinforced concrete, roadway and sidewalk slabs, etc.	25 00	30 00	22 00
1,520 cu.yd. 1:2:4 reinforced concrete, sidewalks, earth fill	30 00	20 00	18 25
272 cu.yd. 1:2:4 reinforced concrete, railings and posts	93 00	60 00	79 00
826 cu.yd. 1:2:4 plain concrete around conduits	15 00	12 00	19 00
2,019 cu.yd. 1:3:5 plain concrete roadway pavement, etc.	10 00	12 00	19 00
5,205 cu.yd. 1:1½:3 reinforced concrete roadway pavement, south approach	15 60	15 00	24 00
56 cu.yd. 1:3 cement mortar protection coat	82 81	40 00	23 40
390 cu.yd. 1:3 cement mortar waterproofing protection coat	71 26	10 00	19 40
90 cu.yd. 1:3 grout for ballast	11 70	15 00	13 00
115 cu.yd. 1:2 cement mortar for fascia girders, etc.	51 18	80 00	61 00
1,843 cu.yd. rock faced granite, piers 10 to 12 and 16 to 28	76 00	93 00	62 90
399 cu.yd. rock faced granite, piers 13, 14 and 15	73 50	93 00	62 90
16,850 cu.yd. back fill around piers, abutments and retaining walls	.77	.50	.50
370 cu.yd. ballast on concrete viaduct	4 16	3 00	5 00
251 cu.yd. broken stone for drains	4 16	3 00	5 60
6,501 gal. bituminous cement	.44	.50	.30
14,685 sq.yd. waterproofing	1 05	1 00	1 30
17,140 sq.yd. 2½-in. asphalt block	2 50	2 80	2 55
1,520 sq.yd. 2 in. asphalt block	2 50	2 60	2 30
40,725 lin.ft. 4 in. fiber conduit	.18	.20	.25
106,089 lin.ft. 3 in. fiber conduit	.17	.15	.22
1,350 lin.ft. 2 in. fiber conduit	.17	.15	.20
658 lin.ft. 4 in. v.t. pipe	.96	1 50	.50
690 lin.ft. 12 in. v.t. pipe	2 12	4 00	4 20
895 lin.ft. 15 in. v.t. pipe	2 69	5 00	4 60
611 lin.ft. 18 in. v.t. pipe	2 16	7 00	5 30
446 lin.ft. 8 in. c.i. pipe	2 25	6 00	5 10
52 lin.ft. 10 in. c.i. pipe	2 82	12 00	6 70
62 lin.ft. 16 in. c.i. pipe	5 36	18 00	12 00
36 lin.ft. 18 in. c.i. pipe	6 56	25 00	14 00
2,000 sq.ft. cobble gutter	.13	.50	.50
211,000 sq.ft. grassing and top soil	.06	.05	.30
11,000 lin.ft. wooden railing	2 48	.60	2 50
415,225 M.B.M. lumber for fenders, etc.	162 00	120 00	120 00
11,513 lb. copper flashing	.37	.80	.60
1,540 lb. sheet lead	.19	.30	.10
1,322,500 lb. steel reinforcement	.075	.06	.05
52,980 lb. clinton wire cloth	.075	.10	.07
214,000 lb. galvanized steel fabric	.055	.10	.08
4,935,000 lb. structural steel for girder spans	.0528	.0567	.055
2,163,000 lb. structural steel for draw span	.0728	.077	.0775
132,720 lb. ornamental steel for hand railing	.1483	.17	.12
234,406 lb. curb angle guard including bolts	.0433	.07	.045
79,754 lb. miscellaneous steel	.0988	.10	.06
84,950 lb. cast steel for girder bearing	.1446	.14	.12
84,830 lb. cast iron for scuppers	.07	.10	.08
31,340 lb. miscellaneous cast iron	.16	.10	.10
283,000 lb. machinery for draw span	.24	.216	.215
145 pull boxes	28 00	60 00	25 00
63 draw boxes and manhole covers	64 00	80 00	50 00
Operator's and gatemen's houses (lump sum)	4,200 00	7,000 00	7,500 00
Bronze name plates and brackets	4,300 00	4,000 00	1,500 00
84 wood lighting poles	125 00	50 00	58 00
Lighting system complete (lump sum)	36,000 00	24,000 00	50,000 00
Electrical equipment for draw span (lump sum)	19,850 00	20,000 00	25,000 00
Extended totals	$3,702,922	$3,778,645	$3,862,847